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Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds. Volume I

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PROCEDURES FOR THE PREPARATION OF EMISSION INVENTORIES FOR VOLATILE ORGANIC COMPOUNDS

VOLUME I

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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Procedures are described for compiling emission inventories of volatile organic compounds (VOC) for use in less data-intensive models such as rollback and the Empirical Kinetic Modeling Approach (EKMA). Such inventories generally represent annual emissions (perhaps with some seasonal information) and are compiled for larger geographical areas such as counties.

The basic inventory elements --planning, data collection, emission estimates, and reporting-- are all discussed. No single prescriptive methodology is presented; rather, a set of procedures is described so that the agency may choose the most appropriate techniques to meet its needs in its oxidant and other programs. Various example are included to aid the agency in the understanding and utilization of this document.

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Office of Air Quality Planning and Standards
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December 1977

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This document has been reviewed by the Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, and approved for publication. Subject to clarification, the contents reflect current Agency thinking.

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ABSTRACT

This guide is intended for general use by the air pollution community in planning and compiling inventories for use in oxidant control strategy development. Emphasis is placed on compiling organic emission inventories; however, to some extent, the planning considerations and procedures described are applicable to inventories in general.

This guide will be published in two volumes. Volume I provides technical guidance on compiling organic emission inventories on an annual or seasonal basis at the county (or county equivalent) level. Such inventories are considered adequate for use in less data-intensive source/receptor relationships that are based on rollback or chemical kinetics considerations. Volume II will provide technical guidance on compiling organic emission inventories at a more detailed level of temporal and spatial resolution than results from the techniques prescribed in Volume I. Specifically, Volume II will describe methodologies for compiling daily and hourly inventories, with emissions being allocated to subcounty grids. This added detail is required so that the inventory can serve as input to various photochemical atmospheric simulation models.

Both Volume I and II are intended to be "stand alone" documents to the extent that the user will not need to refer to numerous other, sometimes unavailable references for procedural details on completing an emission inventory. However, certain primary references that are widely distributed (e.g., AP-42, Compilation of Air Pollutant Emission Factors) are cited in order to cut back on the amount of material that is included in these documents. Generally, these cited references contain certain data elements needed for completing the inventory in a particular area

such as emission factors, activity levels, etc.

This guide contains a set of general technical procedures rather than a single prescriptive guideline for completing an organic emission inventory. Because each user's needs may vary from area to area, and because certain techniques may be more applicable in some areas than in others, no one prescriptive methodology is recommended for use in all circumstances. Rather, a number of optional techniques representing various levels of detail are presented for compiling the inventory. In addition, advantages and disadvantages of these techniques are weighed in order to help the agency decide what level of detail will be sufficient to meet its needs and objectives and, at the same time, what can be accomplished given the constraints that limit the inventory compilation effort.

Any technical guide of this sort represents an evolutionary process and therefore must change to reflect new knowledge and improved procedures. To this end, a punched loose-leaf format has been employed to readily accommodate the addition of future materials. To facilitate the insertion of revised or additional material, the date of issue has been noted on the bottom of each page of the document.

Comments and suggestions regarding this document should be directed to the attention of the Director, Monitoring and Data Analysis Division, Office of Air Quality Planning and Standards, Environmental Protection Agency, Research Triangle Park, North Carolina 27711.

Chapter 1

INTRODUCTION

1.1 Background

Photochemical oxidant (primarily ozone) is produced in the atmosphere when volatile organic compounds (VOC) are mixed with nitrogen oxides (NO_x) in the presence of sunlight. In order for the air pollution control agency to develop and implement an effective oxidant control strategy, information must be compiled on the important sources of these precursor pollutants. This is the role of the emission inventory--to tell the agency what types of sources are present in an area, how much of each pollutant is emitted, and what types of processes and equipment (including control devices) are present at each plant.

While the inventory can serve numerous functions in an oxidant control program, a primary use is as input to the source/receptor model used by the agency to relate emissions of precursor pollutants (VOC and NO_x) to subsequent levels of photochemical oxidant in the ambient air. These models can range in complexity from simple empirical or statistical relationships to detailed atmospheric dispersion models that consider photochemical reactions. Volume I of this guideline is primarily aimed at defining inventory requirements for those less data-intensive source/receptor relationships (e.g., the Empirical Kinetic Modeling Approach[1]).

While VOC and NO_x inventories are both needed for oxidant control strategy development, the use of a less data-intensive source/receptor relationship is more dependent on having reliable information on volatile organic compound emissions. Hence, emphasis in Volume I is placed on compiling the VOC inventory. Volatile organic compounds are broadly defined as those hydrocarbons and hydrocarbon derivatives that readily vaporize under typical conditions.

A major distinction typically made in inventories is between point and area sources. Point sources are those facilities/plants/activities on which individual records are maintained in the inventory. Typically, sources that emit more than some specified level of VOC (e.g. 100 tons/year) are considered as point sources. Depending on the needs of the agency, this cutoff level will vary. Area sources, in contrast, are those activities for which collective source and emission information is maintained. Sources that are not considered as point sources are included as area sources. Numerous techniques are available for obtaining and developing source and emissions information on both types of sources. Perhaps the most common technique for developing emission estimates is through the use of emission factors, such as those found in AP-42, Compilation of Air Pollutant Emission Factors[2], which relate the quantity of pollutant(s) emitted from a source to some level of process activity. These topics are all discussed in detail in later chapters of this document.

Appendix A contains a glossary of important terms used in conjunction with organic emission inventories. These definitions may aid those persons not familiar with organics and/or inventories in better understanding this document and in compiling an organic emission inventory in their area.

1.2 Purpose

The purpose of this document is severalfold. The basic function, of course, is to describe the various techniques that are available to an agency for compiling an emission inventory for oxidant control strategy development. To this end, the bulk of this document is devoted to presenting detailed procedures that an agency may use for gathering and reporting source and emissions information on organic materials. Limited discussion is also included pertaining to inventories of nitrogen oxides.

Before an agency begins to conduct an inventory it must plan the inventory carefully. First, the agency must determine what its specific needs are for an organic emission inventory in its various regulatory programs. Second, it must define specific objectives that the resulting inventory shall meet. Third, it must consider the various requirements and constraints that limit the directions the compilation effort can take. Last, the agency must carefully balance these needs and objectives with the constraints imposed upon the inventory effort. This document explores these various planning considerations, and offers guidance to aid the agency in deciding which inventory approach it should ultimately pursue given the limited resources it has available. It should be noted that this document is not intended to set forth specific legal requirements for emission inventory development (e.g., minimally acceptable requirements for State Implementation Plans), but rather provide a discussion of various techniques that are available.

The major emphasis of this guideline is on the development of an organic emission inventory that is useful in the various facets of an oxidant control program. Thus, when describing the planning and implementation of an inventory, the bulk of the discussion in the document centers on issues that relate to developing a strategy for photochemical oxidant control. The organic inventory can, of course, be useful to the agency in other areas such as in programs dealing with specific toxic organic chemicals. Generally, the procedures in this document will be applicable for developing organic emission inventories for use in these other program areas.

1.3 Format and Contents of Volume I

This document is intended to offer guidance to those engaged in the planning of an organic emission inventory as well as to those charged with the actual inventory compilation effort. It is published in two major parts: Volume I and Volume II. This volume is devoted to presenting step-by-step procedures for compiling the basic organic emission inventory. "Basic" in this context, refers to inventories that provide the type of base line data needed for the simplest photochemical oxidant source/receptor models, such as those based on rollback or chemical kinetics. Generally, the basic inventory will result in emission estimates on an annual or seasonal basis and for relatively large areas (e.g., a county or county equivalent). Volume I, in this respect, outlines the procedures that an agency should consider in compiling an emission inventory if it does not anticipate employing a photochemical atmospheric simulation model.

Emphasis throughout this document is placed mainly on presenting techniques and procedures for gathering and analyzing the basic inventory data. While data handling procedures are necessary to process and record the inventory data, this topic is not addressed at length. Other EPA documents are available that discuss data handling and storage procedures. For those charged with systems development responsibilities, various information is available describing the development, structure, and capabilities of various systems. Those interested in specific information on EPA's National Emissions Data System (NEDS) or Emission Inventory System (EIS) should contact either the National Air Data Branch, Research Triangle Park, N.C. 27711 or the appropriate person (i.e., the NEDS contact) at their EPA Regional Office. Detailed information on NEDS is available in the AEROS Manual Series.[3-5] Detailed information on EIS is available in Reference 6. Limited descriptions of these systems are presented in Appendix B.

Reports are necessary, of course, to present the inventory data in a format useful to the agency in its various regulatory and other programs. Several types of reports are briefly presented in this document that are helpful in different situations. In addition, a standard format is prescribed that is strongly recommended when generating reports of VOC emissions. The use of this format by all agencies will promote the reporting consistency necessary for comparing inventories from one area to another and evaluating the effects of various control strategies.

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Chapter 2

INVENTORY PLANNING, DESIGN, AND PERSPECTIVE

The basic elements of an emission inventory are (a) planning, (b) data collection, (c) analysis, and (d) summarization and reporting (which includes documentation). This chapter is primarily geared toward the planning aspect. As is the case in the management of any complex activity, the initial planning effort should cover a sufficient level of detail so that otherwise unforseen obstacles are identified and avoided which could hinder or delay the successful completion of the project.

Before an agency initiates the actual compilation of an organic emission inventory, it must carefully evaluate what its specific inventory needs are with respect to oxidant strategy development and define what objectives it expects the inventory to meet. This chapter delineates several activities that are necessary in an oxidant control program and describes how an organic emission inventory can play a useful role in carrying out these various activities.

Further, once an agency has determined what its needs are, and what specific objectives it expects the organic emission inventory to meet in its control program, a number of considerations should be made before the agency actually initiates the inventory. These considerations involve various requirements and constraints--technical, economic, and legal--that must be accounted for during the planning stages of the inventory effort. Depending on the needs of the agency conducting the inventory, the amount of time and resources directed to each item of consideration will vary. This chapter provides guidance to help the agency decide how it can best deal with these constraints and requirements within the resources available to design and complete the emission inventory.

2.1 Technical Design Considerations

2.1.1 Emission Estimates and Their Use in Source/Receptor Relationships

A requirement of most oxidant control strategies is the definition of the total quantity of volatile organic compounds emitted from all sources in a given geographical area for a particular period of time. An agency must also be able to identify significant source categories and individual sources of emissions as well as the quantities of volatile organics being emitted from each of these sources. The emission inventory is the obvious tool by which an agency can determine this information.

In addition, the emission inventory must be designed so that the results can be interfaced with control strategy development activities. Various source/receptor relationships are available that can be used to relate source emissions to resulting air quality levels of photochemical oxidants. Some source/receptor relationships--rollback and the Empirical Kinetic Modeling Approach (EKMA)[1]--require considerably less detailed emission data than other, more sophisticated atmospheric dispersion models (e.g., the SAI urban airshed model).[2] In addition to the basic emission inventory information needed for rollback or EKMA, these atmospheric dispersion models require considerable spatial and temporal detail on the emissions of organics, NO, and NO_2. For example, atmospheric simulation models generally require hourly emissions data for each pollutant for relatively small (e.g., 2 kilometer square) grids. Therefore, the agency should predetermine the type of source/receptor relationship it will use in developing its oxidant control strategy prior to designing the emission inventory.

2.1.2 Geographical Area and Spatial Resolution

Inventories can be completed for any geographical area of concern, including the entire nation, a region, a state, an Air Quality Control Region (AQCR), an Air Quality Maintenance Area (AQMA), a county, a city, or some subsections of a city or county. The most important consideration is how small an area can be inventoried and yet provide sufficient information to develop and implement an effective oxidant control strategy.

With respect to emission inventories that will be used with less data-intensive source/receptor relationships, emissions data compiled at the county (or county equivalent) level generally provide sufficient spatial resolution. The county limits are logical boundaries for compiling an emission data base for two reasons. The first is due to the areawide nature of the oxidant problem. Photochemical oxidants are generally not a localized problem, but rather, form after several hours, or in some cases, days as a result of reactions among precursor pollutants emitted over broad geographical areas. Consequently, less spatial resolution is generally required for volatile organic emissions than is necessary for other pollutants for which national air quality standards exist.

The second reason for compiling volatile organic emission inventories on a county basis is due to data availability. The county represents the smallest basic jurisdiction for which various records are kept that are appropriate for use in developing area source emission estimates. Thus, because it provides sufficient resolution for the less data-intensive source/receptor relationships, and because of the convenience it affords the agency, the county is the optimum jurisdictional unit for compiling inventories that will be used in developing an oxidant control strategy. Countywide totals can be added to compile the total emission inventory for the entire area to be inventoried. In some cases, an emission inventory for volatile organic compounds may need to extend beyond the jurisdiction of an agency. For example, a metropolitan area will often encompass a number of counties and may overlap into several states, as in Interstate AQCRs. In these instances, a beneficial approach may be to coordinate the inventory efforts among all of the agencies so that the results will be interchangeable and useful to all groups involved.

2.1.3 Temporal Distribution of Emissions

Inventories can be designed to estimate emissions for any time frame, such as annually, daily, or hourly. Annual emissions data have historically been gathered in most inventory efforts, although seasonal operating information is sometimes included, as well. In certain special cases, more temporal resolution is required. For example, hourly emission estimates are needed in several photochemical atmospheric simulation models (These requirements will be discussed in Volume II.)

Inventories that produce annual emissions data can be used as input to the less data-intensive source/receptor relationships. Indeed, the methodologies described in Volume I are primarily aimed at obtaining annual data. However, high levels of photochemical oxidants generally form during the warmer summer months (typically from June to September) that comprise the "oxidant season." Moreover, the relative emission rates of various sources may be different during the oxidant season than on an annual basis. For example, evaporative emissions from automobiles and gasoline handling and storage operations (both major contributors of organic emissions in urban areas) will increase significantly at higher summertime temperatures. Other sources, whose activity levels increase dramatically during the summer months (e.g., exterior surface coating), will also produce higher oxidant season emissions. Conversely, some sources will exhibit less activity and, hence, fewer organic emissions during the oxidant season. Because of these several reasons, the agency may find it worthwhile to consider adjusting the annual emissions estimates to better reflect organic emission rates during the oxidant season. (Seasonal adjustment of annual organic emission inventories is discussed in Chapter 7).

Appropriate seasonal adjustment is not usually afforded simply by apportioning annual emission rates into shorter time intervals. For example, summertime emission rates for many sources cannot normally be estimated accurately by simply dividing annual emissions by four. Because the use of such oversimplified procedures may lead to considerable error as emissions are frequently quite variable over time, special adjustment techniques are desirable.

2.1.4 Exclusion of Nonreactive Compounds and Consideration of Species Information

While most volatile organic compounds ultimately engage in photochemical reactions, some do so faster than others, and some are considered nonreactive under any atmospheric conditions. EPA has published information[3] on the relative "reactivity" of various organic compound species and has provided guidance on how such compounds should be considered in emission inventories compiled for use in control strategy programs for photochemical oxidants. This information indicates that some compounds (methane, ethane, Freon 112, methyl chloroform, as well as a number of toxic substances) are nonreactive and that emissions of these compounds should be excluded from a base line emission inventory used for oxidant control strategy purposes. The reader is referred to Reference 3 for more detailed information on the subject.

Because both rollback and chemical kinetic source/receptor models (e.g., EKMA) do not require individual organic species data or reactivity classifications (as are required by more sophisticated photochemical atmospheric simulation models), and because most organic compounds are photochemically reactive, the agency need not consider reactivity in detail in the basic inventory. Instead, to the extent feasible, the agency need only attempt to identify that fraction of emissions from each source comprised of nonreactive organics and exclude it from the base line emission total.

Some of the nonreactive volatile organic compounds that should be excluded are chlorinated organics that find principal applications as cleaners for metals and fabrics. Hence, major emitting sources of many of these nonreactive compounds can be readily identified. Unfortunately, methane and lesser amounts of ethane are emitted from many types of non-solvent using sources (e.g., combustion sources), and sufficient information is not currently available in AP-42 or elsewhere for the agency to exclude these compounds. Thus unless specific emission data are otherwise available, the current emission factors in AP-42 (which do not exclude methane or ethane) should be utilized to estimate reactive emissions for these sources. EPA is currently developing improved emission factors that will allow the agency to exclude those organic compounds of negligible photochemical reactivity from its base line emission inventory. These will be published in AP-42 and accompanying documents as they become available.

Because species data can be helpful to the agency in excluding non-reactive compounds from the inventory, the agency should consider obtaining this kind of information. Species information is additionally helpful because it more readily allows the agency to identify sources of toxic organic emissions and because it enhances the agency's flexibility in future activities in considering the reactivity of various compounds as new and improved information is obtained. Further, in areas where atmospheric dispersion models for photochemical oxidants may be used, species information, grouped by chemical classification, will be needed. More detailed information on this subject will be provided in Volume II.

2.1.5 Emission Control Potential

An essential element in control strategy development is the determination of how much oxidant reduction is possible as a result of controlling organic emissions from various sources. Depending on its sophistication, an inventory can serve a number of needs in this area. For example, if information is maintained on the activity levels of each source, the kinds (if any) of solvents used, and the types and efficiencies of control devices, the agency could use this (together with the source/receptor relationship) to predict what the effects would be on emissions and oxidant air quality levels of employing reasonable or best available control technologies or other control measures. Once again, prior consideration of such possible uses of the emission inventory needs to be given in the planning stages to assure the collection of the proper data.

2.1.6 Status of Existing Inventory

A major inventory design consideration, especially if the agency is faced with limited resources, is whether or not an existing inventory can be used as is (or selectively modified) to meet the current needs of the oxidant control program. No specific guidance can be offered here as each existing inventory will obviously differ, as will the current needs of each agency. As a minimum, the existing inventory should be examined to see if the appropriate sources have been included and that the emissions data therein are reasonably representative of current conditions. If, for some reason, an existing inventory cannot meet current needs, and cannot readily be updated or modified, it should not be discarded as totally useless. Previous inventories can at least serve as a starting point for the development of a mailing list. The agency must be careful, however, not to rely on an existing inventory to the degree that sources or source categories are excluded again that may have been erroneously omitted when the original inventory was prepared. In addition, any backup information kept on the existing inventory can be helpful, such as the response time required for questionnaires, specific problems encountered by persons completing questionnaires, etc.

2.1.7 Allowable Error

An important design consideration during inventory development is how reliable the data must be to meet the agency's oxidant program objectives. Unfortunately, it is extremely difficult to determine, quantitatively, either how much overall error exists in an inventory or how much error is allowable in an inventory that is being designed to facilitate oxidant strategy development. Because of the difficulty in dealing with error in a quantitative manner, a more subjective approach is often necessary to address the problem. One approach is to analyze the procedures employed for gathering the data rather than analyzing the data itself. For example, the emission factor is one element that can cause error in the emissions estimate. Because of the difficulty of successfully estimating, quantitatively, all of the errors that may be inherent in each emission factor (for example, factors will be inaccurate in cases where biased sampling techniques are used, and will contain some measure of statistical error when a small number of observations are used to estimate the factor), the agency may conclude that each major source should be individually tested instead of using an emission factor to estimate emissions. The presumption here, of course, is that a specific source test yields less error than does the use of a generalized emission factor to determine emissions. As another example, the agency may determine that actual plant visits are necessary as a more reliable means of obtaining source and control device information than is the use of questionnaires.

As a rule, the more detailed and exacting the procedures are that are used to compile the inventory, the more reliable the resulting data will be and the more resources that will be required. Specific guidance in this area with respect to organic inventory error is difficult to offer because the many inventory end uses allow different degrees of error. In general, the agency should employ the most reliable procedures it can afford, emphasizing those areas of the inventory that are the most important. For instance, automobiles are frequently the largest single organic emission source in many urban areas, and therefore, the agency may deem it worthwhile to employ the best inventorying procedures possible to obtain emission estimates for this source. To accomplish this, the agency could determine both measured vehicle-miles-traveled (VMT) data and locale-specific correction factors for the survey area rather than employ fuel use-based VMT and typical national correction factors. Or, if petroleum product storage and marketing is a major source in an area, the agency may find it reasonable to visit each tank farm, examine each tank's construction, and require detailed records of where and how each product is handled as well as any other variables that may affect emissions.

Of course, the agency should recognize that more exacting inventory procedures usually require more resources. Therefore, during the planning stages, the agency should carefully determine those inventory components to which its oxidant program is most sensitive in order to maximize its effort in getting the best data possible in these areas. Possibly, upon such analysis, crude emission estimates may be sufficient for many areas, thereby allowing the agency to devote more resources in critical areas.

2.1.8 Corresponding Nitrogen Oxides (NOx) Inventory

Nitrogen oxides, along with volatile organic compounds, are precursor emissions that react to form photochemical oxidant. Consequently, a relatively complete NO_x emission inventory is important in an oxidant control program. If atmospheric simulation models are employed, detailed NO_x (as well as organic) emissions patterns may be required as a function of space and time over the area. If the Empirical Kinetic Modeling Approach (EKMA) is used by the agency, an estimate of the change in NO_x emissions that may occur over some time period will be needed to evaluate the corresponding impact on the agency's organic emission control strategy. As with the organic inventory, the level of detail needed in NO_x inventories depends on the uses to which these inventories will be put.

2.1.9 Interfaces with Other Programs/Systems

In some cases, the organic emission inventory may serve as input to, or obtain data from, other programs or data systems that an agency (or other groups) may maintain for various purposes. If the inventory is to serve in this capacity, any such interface should preferably be considered in the inventory planning and design phase as it may have considerable impact on the nature of items included in the inventory as well as how the inventory is structured. It can be very difficult and costly to modify an existing inventory system to interface with other systems or programs after the inventory effort has been completed.

As an example, an agency's permit system is often a valuable source of information. Depending upon their currency and completeness, permits may be useful to identify sources; provide stack, process, and emissions information; and in some cases, may provide sufficient information to preclude requiring a source to complete a questionnaire. A similar source of data would be the agency's compliance/enforcement system. Both systems, or others, can be invaluable sources of information and their use should be taken into consideration when planning and designing the inventory effort.

Other example interfaces might include energy data systems, data systems for other pollutants, and, of course, EPA's Emission Inventory Subsystem (EIS) and National Emissions Data System (NEDS). In this latter regard, it will usually be advantageous for an inventorying agency to initially design and compile its inventory in a format that is compatible with EIS or NEDS for subsequent reporting to EPA. (NEDS reporting requirements are promulgated in Reference 4 and described in Reference 5). One additional advantage of this is that numerous summary routines and various computer modeling programs have been designed to operate on the NEDS data base, including a wide variety of retrieval programs that enable the user to provide summaries of the source, control device, and emissions data in NEDS for a number of geographical areas down to the county level. NEDS and EIS are described briefly in Appendix B, and in more detail in References 5 through 8.

2.2 Legal and Economic Design Considerations

2.2.1 Legal Considerations

Certain legal constraints may confront the agency when compiling the organic emission inventory. Any such legal considerations should be predetermined during the inventory planning process to minimize difficulties during the compilation effort and later. EPA and most states have the legal right to obtain and publish emission information. In certain cases, some process information that is needed to calculate emissions may be deemed confidential and must be handled appropriately. Also, Federal Agencies are constrained in their freedom to request information from private sources under the Federal Reports Act without first obtaining proper clearances. Some states or local agencies may have similar constraints. Possible legal constraints should be explored in the planning stages.

2.2.2 Resources

An underlying design consideration in every inventory activity is the availability of resources. Resources are very seldom unlimited. Thus, the agency must determine which areas warrant the largest resource expenditures and which warrant the least. Resources, in this context, may include manpower, funds, equipment, expertise, and to some extent, calendar time. Consideration should be given to resource requirements outside the agency; for example, costs to sources for completing complex questionnaires, costs to other agencies for supplying area source data, etc. A balance between resource requirements and data requirements should be achieved.

The agency should be aware that more resources are required as the number and complexity of the inventory objectives increase. The agency should make every effort, through careful planning, to optimize the usefulness of the inventory to the overall oxidant program. One way to do this is to maximize, as much as possible, the use of existing materials that are available to the agency. This would include the use of literature references, existing emission factors (such as in AP-42), and existing emission inventory systems (such as EIS or NEDS) that are available from EPA.

2.3 Data Handling and Retrieval

The agency conducting an emission inventory should be aware that data handling and retrieval can be handled manually or by computer. Combinations of these two basic approaches are also possible. The selection of one approach over the other will depend on several factors:

- availability of a computer
- size of the inventory data base
- complexity of the emission calculations
- number of calculations to be made
- variety of tabular summaries to be generated
- availability of clerical and data handling personnel
- time constraints

The computer approach becomes significantly more cost effective as the data base, the variety of tabular summaries, or the number of iterative tasks increases. In these cases, the computer approach generally requires less time and has the added advantage of forcing organization, consistency, and accuracy.

Some of the activities which can be performed efficiently and rapidly by computer include,

- printing mailing lists and labels
- maintaining status reports and logs
- calculating and summarizing emissions
- storing source, emissions, and other data
- generating output reports

Therefore, during the planning stages, an agency should anticipate the expected volume and types of data handling needed in the inventory effort, and weigh the relative advantages of a manual or computerized system. It may prove much to the agency's advantage to computerize many of its data handling and retrieval activities.

With respect to oxidant control, no inherent advantage exists between a manually compiled and maintained inventory as opposed to one that is computerized. Generally, however, if an agency must deal with large amounts of data, a computerized inventory allows the agency to spend more time gathering and analyzing the inventory data as opposed to merely manipulating it. In this sense, the computerized approach is superior in large areas having a diversity of sources comprising a complex inventory.

2.4 Other Design Considerations

Organic emission inventories can be used for reasons other than as input to the agency's overall oxidant program. While the purpose of this document is not to explore any of these other uses, the agency should be aware of this possibility insofar as additional consideration may need to be given to the basic inventory design. In general, if an agency expects other such uses to be made of the organic emission inventory, careful attention must be given during the inventory planning stages to the added requirements such uses may impose. A few of these are discussed briefly below.

2.4.1 Land Use Planning

Emission inventory data is becoming more and more an integral part of land use planning activities. Conversely, land use planning data are useful in projecting future emission levels. Thus, the planning and design phase of an inventory should reflect cognizance of the local land-use planning activities and the interrelationships that exist.

2.4.2 Hazardous Compounds

From time to time, certain organic compounds may be suspected or verified as being hazardous to biological systems. It may be worthwhile to include source and emissions information on these compounds (e.g., benzene) so that the inventory can be helpful in the agency's other regulatory programs. These data are more easily and efficiently collected at the time the basic inventory data are collected for use in the oxidant program. However, it may also be impossible to anticipate all compounds which may be placed in the toxic or hazardous category at some time in the future. The agency is cautioned that while hazardous organic compounds may be included in the inventory, only those volatile organic compounds that are photochemically reactive should be included in the base line inventory for oxidant strategy development.[3]

2.4.3 Location of Ambient Monitoring Sites

To some extent, the organic emission inventory can be utilized to determine where ambient monitors of organic compounds and oxidants should be located. Generally, of course, an agency would primarily rely on existing ambient air measurements, together with meteorological data, in siting monitoring instruments to assure that the magnitude, duration, and extent of an oxidant problem is being measured. However, the inventory can be helpful in situations where no ambient air data exist. For example, the inventory data can indicate where organic emissions are sufficiently strong, sufficiently reactive, and occur at the proper times to result in photochemical oxidant formation. Additionally, an accompanying NO_x inventory could identify areas where oxidant monitors should not be sited because of local scavenging of the oxidant by high NO_x emissions. In this sense, an inventory can be useful to agencies in predicting where monitors should be located, either to ascertain current violations or as part of future maintenance activities.

2.4.4 Other Uses

The agency should be aware of various unique or local uses for which an inventory may be used. An example of such a use might be for computing an emission tax as is employed in some locations. Moreover, when designing the inventory, the agency should make contact with local agencies and even other groups within the agency itself to determine if any proposals or plans have been made that would require any additional considerations to be made.

2.5 Practicality and Common Sense

Any number of practical pointers could be offered to those in the position of planning and designing an inventory. Overall, however, the use of common sense is the most essential item in the conducting and successful completion of any inventory effort. In summary, a number of practical pointers are listed below regarding the overall inventory effort:

1. EMISSION INVENTORY ACTIVITIES RELY HEAVILY ON COMMON SENSE. Make sure that this attitude is displayed during all contacts with sources and that the sources are aware of what is being accomplished. A good public relations atmosphere is worthwhile and will generally benefit the quality of the resulting inventory.

2. AN EMISSION INVENTORY SHOULD BE A CONTINUING ACTIVITY, NOT JUST A "ONE TIME" EXERCISE. To be useful at any time subsequent to its compilation, the inventory should continuously be reviewed and updated to accomodate additional sources, new emission factors, etc.

3. LIMIT REDUNDANT AND UNNECESSARY OR REPETITIVE CONTACTS WITH THE SAME SOURCES. Sources are very sensitive to governmental inquiries concerning their operations. Every effort should be made to get the necessary information as efficiently as possible in order to avoid irritating the sources and running the risk of not getting the inventory data. If sources have already supplied information to the agency (e.g., permit or compliance data), this should be used to the extent possible to minimize or eliminate the need for additional contacts.

4. COLLECT ALL INFORMATION NEEDED BUT NO MORE THAN IS NEEDED TO MEET PREDETERMINED OBJECTIVES. Plant personnel who receive inquiries for data tend to be much more cooperative if they realize the ultimate benefit to be gained by the agency. Incorporation of useless or "nice to know" questions in a questionnaire, for example, will only tend to irritate sources and ultimately result in a lower

quality inventory product. An agency should have a reason for collecting each bit of information.

2.6 Organization and Scheduling

Each inventory element and subelement will require that appropriate resources and personnel are assigned in order to complete the inventory in an organized fashion and meet a predetermined time schedule. The agency must systematically organize all efforts so that each output product will match subsequent input requirements. A flow chart (such as is shown in Chapter 3) should be developed to diagramatically place the various tasks and subtasks in perspective.

Once the basic inventory design and the general schedule are outlined, individual tasks should be delineated and scheduled in detail. For large efforts, some sort of management system is recommended such as PERT (Planning, Evaluation, and Review Techniques) or any of several bar-chart management schemes. As a part of management, individual activities (tasks or subtasks) should be defined and output/input interfaces identified. Most importantly, a "critical path" or string of tasks which control the schedule should be determined. The agency may consult any of a number of project management texts for further information on this subject.

Once the inventory effort is underway, periodic meetings or consultations with the individuals responsible for the identified activities will be necessary, and resources may have to be realigned to assure that the basic inventory objectives are being met on a timely basis.

REFERENCES FOR CHAPTER 2

1. U.S. EPA, OAWM, OAQPS, MDAD. Uses, Limitations and Technical Basis of Procedures for Quantifying Relationships Between Photochemical Oxidants and Precursors, Publication No. EPA-450/2-77-021a, November 1977.

2. Roberts, P. J. et.al. Urban Air Shed Photochemical Simulation Model Study. Volume I. Prepared for U.S. EPA under Contract 68-02-0339 by Systems Applications, Inc., Beverly Hills, CA. EPA Publication No. EPA-R4-73-030. (Note: This Model is being updated in 1977-8 by SAI under EPA Contract 68-02-2429).

3. Recommended Policy on Control of Volatile Organic Compounds. Federal Register -42 (131)-35314-35316, July 8, 1977.

4. Title 40-Protection of Environment. Part 51. Submission of State Reports and Emissions Control Action Programs. Federal Register 38(149)20832-20835, August 3, 1973.

5. U.S. EPA, OAWM, OAQPS, MDAD. AEROS Manual Series, Volume I: AEROS Overview. Publication No. EPA-450/2-76-001, February 1976.

6. U.S. EPA, OAWM, OAQPS, MDAD. AEROS Manual Series, Volume II: AEROS Users Manual. Publication No. EPA-450/2-76-029, December 1976.

7. U.S. EPA, OAWM, OAQPS, MDAD. AEROS Manual Series, Volume III: Summary and Retrieval (Second Edition). Publication No. EPA-450/2-76-009a, July 1977.

8. Comprehensive Data Handling System, Emissions Inventory/Permits and Registration Subsystem (EIS/P&R) Program Documentation and Users Guide. Prepared by IBM Corporation, Gaithersburg, Maryland, for Environmental Protection Agency under Contract No. 68-02-0638. Document No. EPA-450/3-74-045-a. Research Triangle Park, North Carolina, February 1975.

Chapter 3

OVERVIEW OF INVENTORYING PROCEDURES

The next several chapters present the "how to" for compiling the basic volatile organic compound emission inventory. Emphasis is given to methodologies that result in annual emission estimates over broad geographical areas, such as at the county level. Some discussion is devoted to adjusting an annual inventory to reflect organic emissions during the oxidant season, which is the time interval of primary interest from the standpoint of photochemical oxidant production.

A number of inventorying methodologies are presented in these chapters incorporating various levels of detail. Because no one technique can be applied in all situations, alternative approaches are discussed and their merits examined through the use of examples. The agency should apply the basic principles included herein to its specific needs.

Four basic elements are involved in the preparation of an organic emission inventory. The first element is planning. During the planning stages, the agency should balance its various needs for the inventory in its oxidant program (and other programs) with the major resource constraints that limit the compilation effort. Planning is discussed in detail in Chapter 2.

The second basic element is data collection. A number of approaches can be used to obtain source and emissions data in the inventory effort. The most widely employed approach is the mail survey, which involves the use of questionnaires sent out to individual sources. This approach generally requires the preparation of mailing lists to determine which sources are to receive questionnaires. In addition, some sort of tracking system should be developed to keep a log on which sources are sent questionnaires, which sources have responded, and which sources need to be recontacted.

More direct data collection techniques involve plant inspections and field surveys. These techniques can yield better accuracy as they involve the direct assessment of the facilities and activities that are present in the area of concern. However, they are generally the most resource-intensive.

A less direct, and therefore less desirable data gathering approach involves the use of information found in various publications. The use of information in publications should generally be considered as a default procedure when more direct data collection approaches are not available. Publications are primarily employed to estimate activity levels for area sources. Chapter 5 presents specific publication-based procedures for determining appropriate activity levels for the most important area source categories.

Another approach involves the use of available information in various agency files, including existing emission inventories. Compliance and permit files, tax department records, labor department records, etc. sometimes supply the agency with useful source and emissions information. These files can at least alert the agency to the existence of numerous sources for which additional inventory information is needed. Data collection techniques are described in detail in Chapter 4.

The third basic element in the inventory compilation effort involves analysis of the data gathered to develop emission estimates. The best way to determine emissions is to utilize source sampling results or a material balance. If source sampling data are not available, and a material balance cannot be performed, emission factors must be used to estimate emissions. Emission estimation techniques are presented in Chapter 6.

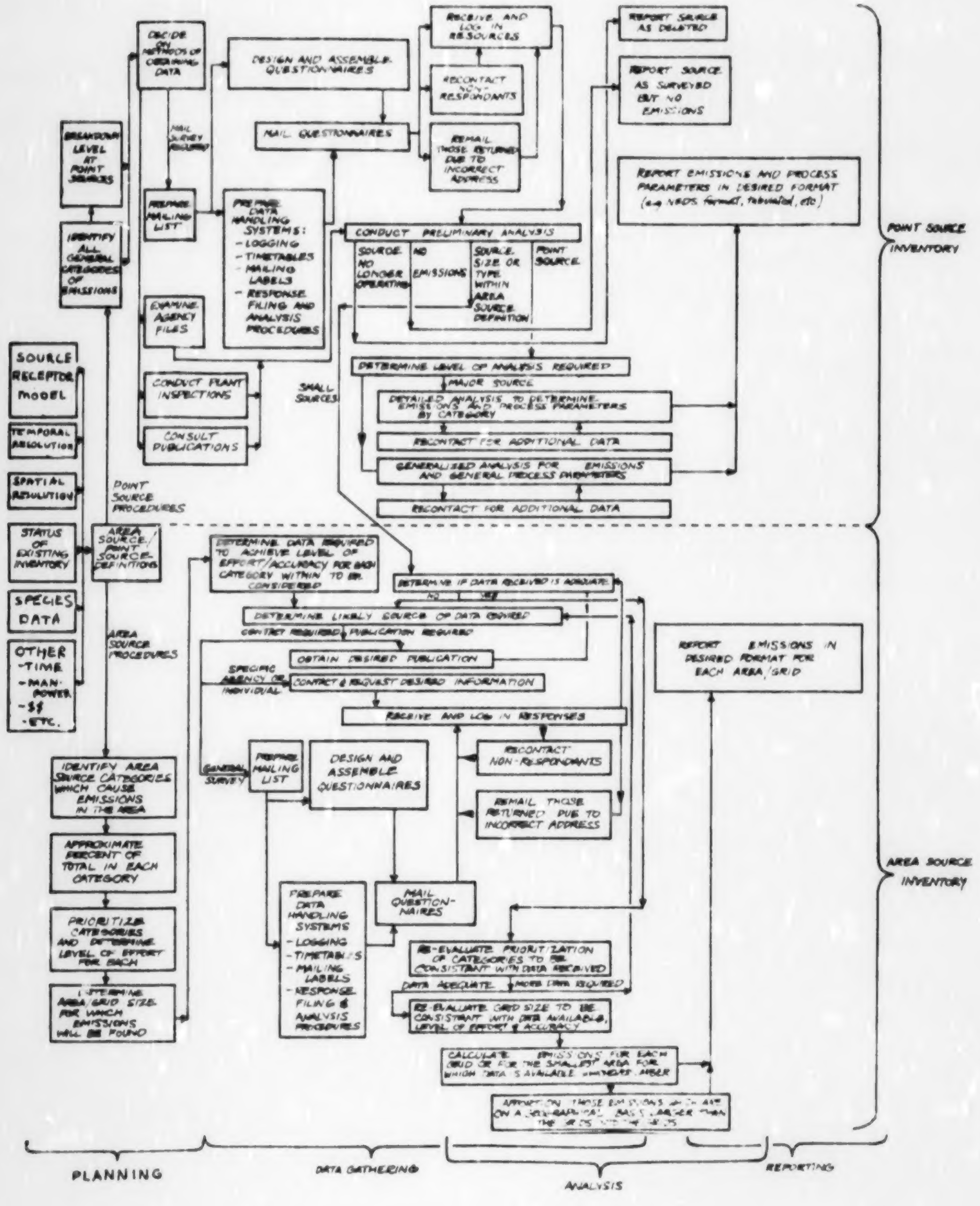
The fourth element is reporting. Basically, reporting involves presenting the inventory data in a format that serves the agency in the development and implementation of an oxidant program or other regulatory effort. Depending on the nature of the system involved, many kinds of reports can be developed that will be useful in numerous facets of the agency's oxidant control effort. Reporting is discussed further in Chapter 8.

Figure 3-1 provides a generalized flowchart outlining the major elements and activities needed in the compilation of the basic organic emission inventory. Each of these activities is described in detail in the following chapters. It should be noted that Figure 3-1 is sufficiently general to encompass the more detailed inventories needed as input to photochemical atmospheric diffusion models. Procedures for completing this type of inventory are detailed in Volume II.

FIGURE 3-1

VOC EMISSION INVENTORY COMPILATION

-FLOWCHART OF GENERAL ACTIVITIES-[1]


DECIDE ON METHODS OF OBTAINING DATA
DESIGN AND ASSEMBLE QUESTIONNAIRES
RECEIVE AND LOG IN RESOURCES
RECONTACT NON-RESPONDANTS
MAIL QUESTIONNAIRES
REMAIL THOSE RETURNED DUE TO INCORRECT ADDRESS
REPORT SOURCE AS DELETED
REPORT SOURCE AS SURVEYED BUT NO EMISSIONS
REPORT EMISSIONS AND PROCESS PARAMETERS IN DESIRED FORMAT (e.g. NEDS format, tabulated, etc)
BREAKDOWN LEVEL AT POINT SOURCES
MAIL SURVEY REQUIRED
PREPARE MAILING LIST
PREPARE DATA HANDLING SYSTEMS: - LOGGING - TIMETABLES - MAILING LABELS - RESPONSE FILING AND ANALYSIS PROCEDURES
IDENTIFY ALL GENERAL CATEGORIES OF EMISSIONS
CONDUCT PRELIMINARY ANALYSIS
SOURCE NO LONGER OPERATING
NO EMISSIONS
SOURCE SIZE OR TYPE WITHIN AREA SOURCE DEFINITION
POINT SOURCE
EXAMINE AGENCY FILES
POINT SOURCE INVENTORY
SOURCE RECEPTOR MODEL
CONDUCT PLANT INSPECTIONS
SMALL SOURCES
DETERMINE LEVEL OF ANALYSIS REQUIRED
MAJOR SOURCE
DETAILED ANALYSIS TO DETERMINE EMISSIONS AND PROCESS PARAMETERS BY CATEGORY
TEMPORAL RESOLUTION
CONSULT PUBLICATIONS
RECONTACT FOR ADDITIONAL DATA
GENERALIZED ANALYSIS FOR EMISSIONS AND GENERAL PROCESS PARAMETERS
SPATIAL RESOLUTION
POINT SOURCE PROCEDURES
RECONTACT FOR ADDITIONAL DATA
STATUS OF EXISTING INVENTORY
AREA SOURCE/POINT SOURCE DEFINITIONS
DETERMINE DATA REQUIRED TO ACHIEVE LEVEL OF EFFORT/ACCURACY FOR EACH CATEGORY WITHIN TO BE CONSIDERED
DETERMINE IF DATA RECEIVED IS ADEQUATE
NO
YES
SPECIES DATA
DETERMINE LIKELY SOURCE OF DATA REQUIRED
CONTACT REQUIRED
PUBLICATION REQUIRED
AREA SOURCE PROCEDURES
REPORT EMISSIONS IN DESIRED FORMAT FOR EACH AREA/GRID
OTHER -TIME -MAN-POWER -$$ -ETC.
OBTAIN DESIRED PUBLICATION
SPECIFIC AGENCY OR INDIVIDUAL
CONTACT & REQUEST DESIRED INFORMATION
RECEIVE AND LOG IN RESPONSES
GENERAL SURVEY
PREPARE MAILING LIST
DESIGN AND ASSEMBLE QUESTIONNAIRES
RECONTACT NON-RESPONDANTS
IDENTIFY AREA SOURCE CATEGORIES WHICH CAUSE EMISSIONS IN THE AREA
REMAIL THOSE RETURNED DUE TO INCORRECT ADDRESS
APPROXIMATE PERCENT OF TOTAL IN EACH CATEGORY
AREA SOURCE INVENTORY
PREPARE DATA HANDLING SYSTEMS - LOGGING - TIMETABLES - MAILING LABELS - RESPONSE FILING & ANALYSIS PROCEDURES
MAIL QUESTION-NAIRES
PRIORITIZE CATEGORIES AND DETERMINE LEVEL OF EFFORT FOR EACH
RE-EVALUATE PRIORITIZATION OF CATEGORIES TO BE CONSISTANT WITH DATA RECEIVED
DATA ADEQUATE
MORE DATA REQUIRED
DETERMINE AREA/GRID SIZE FOR WHICH EMISSIONS WILL BE FOUND
RE-EVALUATE GRID SIZE TO BE CONSISTANT WITH DATA AVAILABLE, LEVEL OF EFFORT & ACCURACY
CALCULATE EMISSIONS FOR EACH GRID OR FOR THE SMALLEST AREA FOR WHICH DATA IS AVAILABLE WHICHEVER IS LARGER
APPORTION THOSE EMISSIONS WHICH ARE ON A GEOGRAPHICAL BASIS LARGER THAN THE GRIDS INTO THE GRIDS
PLANNING
DATA GATHERING
ANALYSIS
REPORTING

An important consideration that affects all aspects of the inventory regards those sources that emit volatile organic compounds and should be given primary consideration in the compilation effort. Table 3-1 presents those major sources of VOC that, as a mimimum, should be considered in the inventory. Some sources on this table are generally considered point sources, some are generally handled collectively as area sources, while some (e.g., drycleaners) can be either point or area sources depending on the size of each operation and the particular cutoff the agency chooses to make between point and area sources. Also, the entries in this table are necessarily generic and do not list all of the emitting points that may be associated with any of the particular source categories. For example, petroleum refining operations actually include many emitting points ranging from process heaters to individual seals and pumps. General process, emissions, and control device information on these sources can be obtained from AP-42, Compilation of Air Pollutant Emission Factors.

Those stationary sources of VOC for which EPA is defining reasonable available control technology (RACT) are included in Table 3-1. Additional process, emission, and control device information is available on these sources in Control Technology Documents available from the Director, Emission Standards and Engineering Division, Research Triangle Park, NC 27711.

- PETROLEUM REFINERIES
  - Refinery Fugitives (leaks)
  - Miscellaneous Sources
    - a) Process Drains and waste Water Separators
    - b) Vacuum Producing Systems
    - c) Process Unit Blowdown
  - Other

- STORAGE, TRANSPORTATION and MARKETING of PETROLEUM PRODUCTS
  - Oil and Gas Production Fields
  - Natural Gas and Natural Gasoline Processing Plants
  - Gasoline and Crude Oil Storage[1]
  - Ship and Barge Transfer of Gasoline and Crude Oil
  - Bulk Gasoline Terminals[2]
  - Gasoline Bulk Plants[3]
  - Service Station Loading (Stage I)
  - Service Station Unloading (Stage II)
  - Others

- INDUSTRIAL PROCESSES
  - Organic Chemical Manufacture
  - Paint Manufacture
  - Vegetable Oil Processing
  - Pharmaceutical Manufacture
  - Plastic Products Manufacture
  - Rubber Products Manufacture
  - Textile Polymers Manufacture
  - Others

- INDUSTRIAL SURFACE COATING
  - Large Appliances
  - Magnet Wire
  - Automobiles
  - Cans
  - Metal Coils
  - Paper
  - Fabric
  - Metal Furniture
  - Wood Furniture
  - Flat Wood Products
  - Other Metal Products
  - Others

- NON-INDUSTRIAL SURFACE COATING
  - Architectural Coatings
  - Auto Refinishing
  - Others

- OTHER SOLVENT USE
  - Degreasing
  - Dry cleaning
  - Graphic Arts
  - Adhesives
  - Cutback Asphalt
  - Other Solvent Use

- OTHER MISCELLANEOUS SOURCES
  - Fuel Combustion
  - Solid Waste Disposal
  - Forest, Agricultural, and Other Open Burning

- MOBILE SOURCES
  - Highway Vehicles
    - a) Light Duty Automobiles
    - b) Light Duty Trucks
    - c) Heavy Duty Gasoline Trucks
    - d) Heavy Duty Diesel Trucks
    - e) Motorcycles
  - Off-Highway Vehicles
  - Rail
  - Aircraft
  - Vessels

[1] Includes all storage facilities except those at service stations and bulk plants.

[2] Emissions from loading tank trucks and rail cars.

[3] Emissions from storage and transfer operations

Table 3-1. Sources of Volatile Organic Compounds (VOC)

REFERENCES FOR CHAPTER 3

1. Bartosh, C.P. et al. Guideline Document for the Preparation of Volatile Organic Compound Pollutant Emission Inventories. Draft. Prepared for U.S. Environmental Protection Agency Under Contract 68-02-2608 (Task No. 2) by Radian Corporation. Austin, Texas. June 1977.

Chapter 4

DATA COLLECTION

Although many activities comprise the inventorying effort, the one activity that is usually the most difficult and consumes the most resources is that of obtaining the data necessary to compile the inventory. Various approaches are available for gathering inventory data; the use of any particular approach or combination of approaches depends on the resources available to the agency and the desired accuracy of the resulting inventory. This chapter presents the most commonly followed approaches for collecting data. Advantages and disadvantages of employing one or another approach in a particular circumstance are weighed. Some of these approaches are more suitable for obtaining point source data; some are more appropriate for obtaining area source data; whereas some approaches can be used for either in certain situations. The most appropriate applications of each approach will be discussed. Chapter 5 presents details on obtaining collective activity levels for the more important area sources of volatile organic compounds.

4.1 Questionnaires (Mail Survey Approach)

Probably the most common technique used by air pollution control agencies for gathering emission inventory data is the mail survey. The primary purpose of a mail survey is to obtain source and emission data by means of a questionnaire mailed to each facility. In order to conduct this type of data gathering operation efficiently, the facilities to be surveyed must be identified; mailing lists must be prepared; questionnaires must be designed, assembled and mailed; data handling procedures must be prepared and organized; and response receiving systems must be established. The following sections discuss the details of each of these general operations.

Questionnaires are generally utilized for directly soliciting equipment, operating, and emissions data from point sources (i.e., those larger sources for which individual records are kept in the inventory file). However, they can be useful in some instances for gathering data on area sources (i.e., sources that are reported on collectively in the inventory). For example, questionnaires can be sent to fuel suppliers to determine the amounts of fossil fuels burned by homeowners, even though residential combustion is generally treated as an area source. In addition, many sources that are sent questionnaires because the agency thinks they might be point sources may turn out to be negligible emitters of organics. In such cases, these sources may be lumped in with an area source category rather than considered individually in the inventory. The agency can reduce or eliminate the receipt of responses from insignificant sources by screening the mailing list before the questionnaires are sent out, as is discussed in Section 4.1.2.

4.1.1 Preparing the Mailing List

A necessary step in the mail survey is the preparation of a mailing list that tabulates the name, address, and general process category of each facility to be surveyed. The basic function of the mailing list is to identify those sources to which questionnaires will be sent. The mailing list may also serve other functions. For example, the general process category information obtained from the mailing list can assist the agency in the determination of those categories for which questionnaires must be designed. In addition, the size of the resulting mailing list gives the agency an indication of how many of what kinds of sources may have to be considered in the inventory. In this regard, the mailing list thus can be used as an important planning tool that can help the agency determine if the resources allocated for the compilation effort will be sufficient. Frequently, more sources are identified than are believed to exist in the initial planning stages.

The mailing list is compiled by utilizing a variety of sources of information, including the following:

- Existing inventories - An existing inventory is a good starting point if it is not over several years old or if it is frequently updated and well documented. Caution is in order since many inventories are compiled for pollutants other than organics; hence, certain sources that emit only organics (e.g., many solvent users) may not be well represented in other inventories. Conversely, some sources that may be considered area sources of other pollutants (and, thus treated collectively) may need to be treated as point sources in the organic emission inventory.

- Other air pollution control agency files - Compliance, enforcement, permit application, or other files maintained by the state air pollution control agency as well as local air pollution control agencies (or health departments) may provide considerable valuable information on the location and types of sources that exist in a particular jurisdiction. These files can also be utilized later to cross-check certain information supplied on questionnaires.

.Other state agency files - Files maintained by labor departments and tax departments are frequently valuable for aiding in the preparation of the mailing list. This would include various state industrial directories wherein companies are listed alphabetically by SIC and county. The types of information available in these files will vary from state to state; hence, it is advisable to contact the appropriate personnel within these agencies to become familiar with what listings are available.

.Industry publications - The following publications may be consulted, where available:

- Dun and Bradstreet, Million Dollar Directory[1] - Companies with sales over $1,000,000 a year are compiled by SIC and county.
- Dun and Bradstreet, Middle Market Directory[2] - Companies with sales between $50,000 and $1,000,000 a year are compiled by SIC and county.
- Dun and Bradstreet - Industrial Directory[3]
- National Business Lists[4] - Companies are listed by SIC and county with information on financial strength and number of employees.
- Trade and professional society publications - Names and addresses of members are listed along with their type of business.

- Thomas Register[5] -

.Yellow Pages - This source will supply the name, address, and phone number of certain sources (e.g., dry cleaners) that are important in the organic emission inventory.

.Manufacturers and suppliers - Firms that make or supply solvents and organic control equipment such as adsorbers, incinerators, or catalytic oxidizing devices. These firms may be able to provide information concerning the existence and locations of important sources of organic emissions.

In all cases, special attention should be given to the Standard Industrial Classification (SIC) category associated with each source on the mailing list, where it is known. If the SIC corresponds to one given in Table 4-1 there is an increased likelihood that it may be an important source of organic emissions. (Note: SICs are a series of codes devised by the U.S. Office of Management and Budget to classify establishments according to the type of economic activity in which they are engaged. See Reference 6.)

Once these various sources have been consulted to develop the mailing list, the entries therein should be ordered to enhance the mailing and followup activities that are necessary. A logical order in which to list and classify companies is first by city or county, then by SIC, and finally alphabetically within the city or county. This order will increase the efficiency of all future work involved in data handling and in recording and analyzing response information. Visual spot-checking

General 2-Digit SIC Categories		Specific 4-Digit SIC Categories	Emission-Per-Employee Ranges (tons/employee/yr)
20	Food	Alcoholic beverages (2085)	0.075
21	Tobacco	Not surveyed	-
22	Textiles	Coatings (2295), Non-wovens (2297), Dyeing (2231)	0.563-0.89
23	Apparel	Not surveyed	-
24	Lumber & wood	Finished product (2435), (2492)	0.024-0.07
25	Furniture & fixtures	SIC: (2511), (2514), (2521) (2522), (2542)	0.08-0.24
26	Paper	Bags, box (2643), 2651), (2653), Coated papers (2641)	1.0-1.25
27	Printing	Newspaper publishing (2711) Comm. printing (2751), (2754)	0.08-0.5
28	Chemicals	Organic chemical mfg. (2821), (2823), 2861), Chemical coating (2851), Specialty chemicals (2842), Carbon black (2895)	0.32-0.357
29	Petroleum	All companies	0.11-2.12
30	Rubber, plastic	Footwear (3021), Plastics (3041), (3069)	0.16-0.256
31	Leather	Mfg. shoes (3149), Bags (3161), Personal goods (3172), Leather refinishing (3111)	0.13
32	Stone, clay, etc.	Glass products (3221)	0.03-0.092
33	Primary metal	Treating (3398), Tubing (3357)	0.10-0.267
34	Fab. metal	Screws (3451-2), Metal stampings (3469), Plating (3471), Tool mfg. (3423), (3429)	0.19-0.281
35	Machinery	Industrial machines	0.03-0.048
36	Elect. Machinery	Devices (3643), Semicond. (3674)	0.04-0.07
37	Transpt. equip.	Boats (3732), Truck bodies (3711), 13, 14, 15)	0.11-0.855
38	Instruments	Optical frames (3832) Precision instruments (3825)	0.04-0.199
39	Misc. Mfg.	Jewelry (3914-15), Toys (3944), Writing instr. (3951, 53)	0.07-0.259
5171	Bulk terminals	All surveyed	-
7216	Dry cleaning	All surveyed	-

Table 4-1. Standard Industrial Classifications (SICs) Associated With VOC Emissions: Emission-Per-Employee Ranges[7,8]

of the resulting listing will easily eliminate many of the duplications.

4.1.2 Limiting the Size of the Mail Survey

If many more sources are identified on the mailing list than can be handled within available resources, several options are available to the agency. One option is to screen the mailing list in some manner to reduce the number of facilities questionnaires will be sent to. This can be done in a number of ways. One way is to limit the mailout to only those sources that are known to be major point sources, i.e., that annually emit more than a certain quantity of organic material (e.g., 100 tons). If the source's annual activity level is known, a material balance or an appropriate emission factor can be applied to get an estimate of annual emissions. For example, if a dry cleaner only purchases five tons of cleaning solvent in a year, its emissions could not exceed 100 tons/year even if all of the solvent evaporated. Hence, it would not be sent a questionnaire if the cutoff level were chosen to be 100 tons/year.

In many instances, the number of employees in a company will be known and an estimate of the potential magnitude of emissions from a particular source can be made by applying emission-per-employee factors such as are shown in Table 4-1. The range of emissions in Table 4-1 for some 2-digit Standard Industrial Classification (SIC) categories suggests that this technique will yield, at best, crude estimates of a source's annual emissions. If the agency has sufficient resources, it is better, of course, to use the higher values of these emission-per-employee factors, as this will result in questionnaires being sent to more sources.

Another method for reducing the mailing list to a manageable size is to make telephone contacts to selected sources within each major category. If there is any doubt about a particular type of source being a potentially large emitter, a call to the plant manager or other appropriate person at a few representative facilities within an SIC can indicate if organic emitting processes are common. Moreover, by obtaining activity levels or the number of employees, the agency can estimate what size facility within the SIC category will be of sufficient size to warrant a questionnaire.

Still another way to limit the size of the mailout is to send questionnaires to a representative sample of sources within each SIC. When this is done, the agency will have to extrapolate emissions for the missing sources based on the sample results. Techniques for "scaling up" an inventory to account for missing or inadequate responses are presented in Chapter 6.

4.1.3 Designing the Questionnaires

After the mailing list has been prepared, a questionnaire must be prepared for each facility to be contacted. This can be done either by preparing a specific questionnaire for each source category or by preparing one or several standardized questionnaires that encompass many source categories. If sufficient resources are available, industry-specific questionnaires are advantageous for certain sources. Such questionnaires will generally be shorter because questions need not be included that are not applicable to the industry. In addition, industry-specific terminology (special units, etc.) can be used that is familiar to those working in a particular industry but which may not be understood by others. This can enhance communication and reduce confusion. For these reasons, inventory accuracy is increased when industry-specific questionnaires are used. On the other hand, this approach has several disadvantages. One, of course is that the development of industry-specific questionnaires requires more resources. Second, the returned questionnaires cannot all be handled in the same way because of the variations in format that will exist from questionnaire to questionnaire. Third, incorrect industry-specific questionnaires may be sent to some sources because of limited knowledge of the operations at these sources before the inventory is completed. Generally, if the mailing list is long, if the agency is unfamiliar with many of the sources on the mailing list, or if agency resources are limited, the use of general questionnaires may be advisable. Oftentimes, in practice, a general questionnaire is merely a collection of industry or process-specific questionnaires sent out as one questionnaire.

Proper questionnaire design includes the establishment of a suitable format, the selection of appropriate questions, proper wording of the questions, and the development of an appropriate cover letter and instructions for filling out the questionnaire. The basic rule is to design the questionnaire for the person who will be asked to complete it. The agency should not overlook the fact that the person who will complete the questionnaire may not have the benefit of a technical background in air pollution. Hence, questionnaires should generally be designed to be understood by persons without specialized technical training.

The format of the questionnaire should be as simple and as functional as possible. When data handling is to be done by computer, time will generally be saved if the questionnaire format is such that a keypunch operator can readily keypunch the information directly from each questionnaire. The questions should be well spaced to ensure that they are easy to read, and so that sufficient area is left for complete responses. The questionnaire should be placed on as few pages as possible because most people tend to avoid long questionnaires. Also, shorter questionnaires reduce postage costs. When preparing the questions, use terminology with which the recipient will be familiar. Each question should be self-explanatory or accompanied by clear directions. All information that will be utilized should be asked for initially, thus avoiding requests for additional data at a later time. This may include asking questions on area source information if this is to be collected using questionnaires.

Each questionnaire sent out should be accompanied by a cover letter stating the purpose of the study and citing any statutes that require a response from the recipient. Cooperation should be respectfully requested in filling out and returning the questionnaire. In addition, each questionnaire should be accompanied by a set of general procedures and instructions telling the recipient how the questionnaire should be filled out, by what date, and when it should be returned to the agency. In lieu of putting a specific reply date in the cover letter, a specific number of calendar or working days to respond can be included. In this manner, delays in mailouts will not require the changing of the reply date in each letter. If a general questionnaire is sent out, the instructions should carefully explain that the questionnaire has been designed for a variety of operations and that some questions or sections of the questionnaire may not apply to a particular facility. In all cases, a contact name, telephone number, and mailing address should be supplied in case a recipient has questions. The cover letter and instructions can be combined in some cases, but should only be done so when the instructions are brief. An example cover letter and set of instructions are shown in Figure 4-1. Additional examples are presented in Appendix C.

When determining what information to request on the questionnaire, the ultimate use of the data should always be considered. In addition to general source information (e.g., location, ownership, nature of business, etc.), correct process information should also be requested. Since activity levels (i.e., indicators of production, fuel consumption, etc.) are generally used in conjunction with emission factors to estimate emissions from most sources (for which source test data is not available), the appropriate activity levels must be obtained for each type of source. The type of activity levels needed to calculate emissions are available in AP-42 for most organic emitters. In addition, since many of the emission factors in AP-42 represent emissions in the absence of any controls, control device information should also be obtained in order to estimate emissions after controls. Control device information is also helpful for determining potential reductions in emissions that could be affected by applying various control strategies (e.g., reasonable available control technology). Finally, any information that is needed to make corrected or adjusted emission estimates should be solicited. For example, since emissions from petroleum product storage and handling operations are dependent on a number of variables, including temperature, tank conditions, etc., appropriate values for these variables should be

Example Cover Letter

(Mailing list address) (Agency address)

RE: Source Questionnaire

Dear Sir(s):

The (agency or department) is currently conducting an inventory of atmospheric emissions of volatile organic compounds from stationary sources in (geographical area). Your cooperation is required under (statute) to provide information necessary to assess volatile organic compound emissions from equipment and processes in your plant by completing the enclosed questionnaire.

Certain emission-related data on your equipment or processes have been extracted from available records. The information requested on the enclosed forms is not available from current agency records and is needed to assess current base line emissions, control potential, and to project future emissions. Your assistance will improve the accuracy of the survey. Please complete the enclosed questionnaire and return it within (time period) to the address indicated on the form.

Any questions regarding these forms should be directed to

(name, address, phone number)

Your cooperation in providing the requested information within (number) weeks from receipt of this letter will contribute materially to the accurate assessment of emissions in (area). Thank you for your assistance.

Sincerely

(name and title)

Attachments

Figure 4-1 Example Questionnaire Package

GENERAL INSTRUCTION

ORGANIC SOLVENT SOURCE QUESTIONNAIRE

1. All questions should be directed to (name, address, phone number)

2. This questionnaire is aimed at obtaining information from a wide variety of solvent users. The complete questionnaire includes the following pages:

   Page A - GENERAL INFORMATION
   B - DEGREASING OPERATIONS
   C - DRY CLEANING OPERATIONS
   D - PROTECTIVE OR DECORATIVE COATINGS
   E - FABRIC OR RUBBERIZED COATINGS
   F - MISCELLANEOUS SURFACE COATINGS
   G - OVENS
   H - PRINTING
   I - GENERAL SOLVENT USE
   J - BULK SOLVENT STORAGE
   K - CONTROL AND STACK INFORMATION

3. Data should reflect calendar year (year) or whichever is more readily available. Specify any other 12-month period that may be used.

4. Fill in the descriptive information and amount of solvent or solvent containing materials used for each device operating under county permit as shown in the example on each page. (Note: these examples are for illustration only and may not represent actual operating conditions.)

5. In the event that data are not available on an individual device basis, use best estimates from total plant usage to complete Item 4.

6. If the type(s) and/or percentages of solvents in coatings, inks, etc. are not known, include sufficient information on the manufacturer, type and stock number so that this breakdown can be obtained. A copy of a supplier's invoice would be adequate.

7. Complete Pages I, J and K.

8. The emissions data that will be generated during this program will generally be public information. If certain process, operation, or material information is considered confidential and should be considered a trade secret, indicate such (specify a procedure and specify how confidential data will be handled).

Fig. 4-1 (cont'd.)

PAGE A

ORGANIC COMPOUND EMISSIONS QUESTIONNAIRE

Mail Questionnaires in the
Enclosed Envelope To:

Please Address All Questions To:

NOTE: ALL DATA SHOULD REPRESENT CALENDAR YEAR

GENERAL INFORMATION

Company Name ____________________

Plant Address ____________ City ____________ Zip ______

Mailing Address ____________ City ____________ Zip ______

Person to Contact About Form ____________________

Telephone ____________ Ti[illegible] ____________

Approximate Number of Employees ________

Nature of Business (Include SIC) ____________________

____

Normal Operating Schedule for Calendar Year ________

________ Hrs/Day ________ Days/Week ________ Weeks/Year

Approximate Percent Seasonal Operation:

Dec.-Feb.	Mar.-May	June-Aug.	Sept.-Nov.

Are hydrocarbon or organic solvent containing materials such as cleaning fluids, coatings, adhesives, inks, etc. used in your operation?

_____ Yes _____ No If yes, please complete the appropriate forms enclosed. Make additional copies if necessary. If organic solvents are not in use or your company does not wish to participate in the survey, please sign and return.

____________________ Signature

____________________ Date

Figure 4-1 (cont'd.)

DEGREASING OPERATIONS

PAGE B

1. Materials Processed ______________________

2. Type and Amount of Solvents Used:

County Permit Number	Type of Degreasing*	Type(s) of Solvents Employed†	Amount of Solvents Added (Gal/Yr)	Amount of Solvent Removed for Reprocessing (Gal/Yr)	Normal§ Operating		
					Hr	Day	Week
EXAMPLE		Perc	2000	500			
P99999	Vapor				8	5	50

---

*Cold cleaning, vapor degreasing

†Stoddard, 1,1,1, trichloroethane, perchloroethylene, methyl chloride, trichloroethylene, other (specify.)

§Normal operating period - hrs/day, days/wk, and wk/yr. .If the approximate percent seasonal operation differs from that on Page A, please indicate.

Figure 4-1 (cont'd.)

DRY CLEANING

PAGE C

1. Material Being Cleared: ____________________

2. Type and Amount of Cleaning:

County Permit Number	Amount of Clothes Cleaned (Tons/Yr)	Type of Cleaning*	Type(s) of Cleaning Solvents†	Amount (Gal/Yr)	Normal§ Operating Hr	Day	Week
EXAMPLE P99999	2000	Hot	Perc	2000	8	5	50

*Hot unit (washing/extraction/drying in one machine) or transfer unit (use of a separate recovery tumbler)

†Perchlorethylene, Stoddard, other (specify)

§Normal operating period - hrs/day, days/wk, and wk/yr. If the approximate percent seasonal operation differs from that on Page A, please indicate.

Figure 4-1 (cont'd.)

PROTECTIVE OR DECORATING COATINGS

PAGE D

1. Materials Coated ____________________

2. Type and Amount of Coating Used:

County Permit Number	Application Method*	Type of Coating†	Amount of Coating (Gal/Yr)	Type and % of Major Solvents		Type and Amount of Solvents Added (Gal/yr)		Method of Drying- (Air, Heat Treated)	Normal Operating§		
									Hr	Day	Week
EXAMPLE P99999	Spray	Enamel	2000	MEK	60 %	Toluene	200	Oven	8	5	50

3. Type of Cleaning Solvent: ____________________, Amount ________(Gal/Yr)

*Spray, dip, roller, flow, etc.

†Paint, varnish/shellac, lacquer, enamel, primer

§Acetone, isopropyl alcohol, MEK, butyl acetate, cellusolve, toluene,¶ other (specify)

¶Normal operating period - hrs/day, days/wk, and wk/yr. If the approximate percent seasonal operational differs from that on Page A, please indicate.

Figure 4-1 (cont'd.)

FABRIC OR RUBBERIZED COATING APPLICATION PAGE E

1. Materials Coated ________________

2. Type and Amount of Coating Used:

County Permit Number	Application Method*	Type of Coating†	Amount of Coating (Gal/Yr)	Type and % of Major Solvents		Type and Amount of Solvents Added (Gal/yr)		Method of Drying- (Air, Heat Treated)	Normal Operating§ Hr	Day	Week
EXAMPLE				Toluene	60%	Toluene	200	Air			
P99999	Lamination	PVC	1000	Xylene	40%				8	5	50

3. Type of Cleaning Solvent ________________, Amount __________ Gal/Yr

mpregnation, "wet" coating, hot melt coating, lamination

olyvinyl chloride, polyurethanes, etc.

oluene, naptha, mineral spirits, MEK, xylene, chlorinated hydroacrbon, other (specify)

ormal operating period - hrs/day, days/wk, wks/yr. If the approximate percent seasonal operation differs from that given on Page A, please indicate.

Figure 4-1 (cont'd.)

MISCELLANEOUS SURFACE COATING APPLICATION (ADHESIVES, PAPER, LEATHER, FILM, GLASS, ETC.)

PAGE F

1. Materials Coated ________________

2. Type and Amount of Coating Used:

County Permit Number	Application Method*	Type of Coating†	Amount of Coating (Gal/Yr)	Type and % of Major Solvents		Type and Amount of Solvents Added (Gal/yr)		Method of Drying (Air, Heat Treated)	Normal Operating¶		
									Hr	Day	Week
EXAMPLE				Toluene	60%	Toluene	200				
P99999	Spray	Adhesive	1000	MEK	40%			Air	8	5	50

3. Type of Cleaning Solvent ________________, Amount _______(Gal

---

* Spray, flow, dip, roller, brush, etc.

† Adhesive type, pigment coating, barrier coating, polymeric coating, inorganic coating, etc., (specify)

§ Branched alcohol, linear alcohol, ethyl acetate, toluene, exylene, ethers, MEK, naptha, other (specify)

¶ 1975 normal operating period - hrs/day, days/wk, and wk/yr. If the approximate percent seasonal operation differs from that given on Page A, please indicate.

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Figure 4-1 (cont'd.)

PAGE G

OVENS AND OTHER HEATED EQUIPMENT
(INCLUDE HEATED DEVICES WITH INTEGRAL OVENS ALREADY REPORTED ON OTHER FORMS)

1. Material Being Dried ______________________

2. Operational Data:

County Permit Number	Operation*	Heating Method†	Heater Rating (Btu/hr) and Temp (°F)	Permit Numbers of Spray Booth(s) or Coater(s) Feeding Oven	Normal Operating§		
					Hr	Day	Week
EXAMPLE P99999	Batch	Gas (IF)	10,000 700 °F	P99998	8	5	50
				P99997			

*Batch or continuous

†Electric, steam, waste heat or gas. If gas fired, specify: Indirect-Fired (IF) products of combustion not mixed with oven gases. Direct-Fired Fresh Makeup (DFFM, products of combustion mixed with oven gases. Direct-Fired Recirculation (DFR, oven gases used as combustion air supply.

§Normal operating period.

Figure 4-1 (cont'd.)

PRINTING

PAGE H

1. Material Being Coated ____________________

2. Type of Printing Process and Amounts of Solvents Used:

County Permit Number	Printing Process*	Type of Ink†	Amount (Gal/Yr)	Type and % Major Solvents In Ink§		Type and Amounts of Solvents Added (Gal/Yr)§		Normal Operating● Hr	Day	Week
EXAMPLE P99999	Flexigraphic	Alcohol Solvent Based	2000	Isopropanol	70	MEK	100	8	5	50
				Methanol	15					
				Ethanol	15					

3. Type & Amount Cleaning Solvent Used ________________ Amount ______________ Gal/Yr

*Letterpress, flexographic, lithographic, gravure, screen

†Solvent based, oil based, lacquer type, etc.

§Isopropyl alcohol, ethanol, propanol, naptha/mineral spirits, toluene, MEK, other (specify)

●Normal operating period - hrs/day, days/wk, wks/yr. If the approximate percent seasonal operation differs from that given on Page A, please indicate.

Figure 4-1 (cont'd.)

GENERAL SOLVENT USAGE

Type and amount of other solvents not identified with equipment having a county permit that were used at your facility during calendar year

Do not include any solvents that have been included elsewhere in this questionnaire.

TYPE	AMOUNT (GAL/YR)

SOLVENT RETURNED

List any solvents returned to supplier or collected for reprocessing. Again, do not include any solvents that have been so specified elsewhere in this questionnaire.

TYPE	AMOUNT (GAL/HR)

Figure 4-1 (cont'd.)

PAGE J

BULK SOLVENT STORAGE

Complete the following information for each storage tank greater than 250 gallons capacity.

Tank No.	Solvent Type	Capacity	Annual Thruput	Type of Fill and Control Equipment*

* Submerged fill, splash fill, return vent line, adsorber.

OPERATIONAL MODIFICATIONS

Please state the changes in type and estimated annual consumption of solvent planned for all operations for calendar years   Include any information on control equipment additions or modifications.

Figure 4-1 (cont'd.)

CONTROL AND STACK INFORMATION

INSTRUCTIONS:

1. Provide information on all devices that emit organic compounds through a stack, vent or other defined emission point. Identify all units under separate permits that vent through a common stack. A simple drawing may be provided to better illustrate the physical configuration.
2. Identify the primary organic compound control method used (if any) such as after burners, scrubbers, carbon adsorption, condensers, etc. Note: this device may have its own permit number. If so, identify.
3. Indicate installation date of control equipment.
4. Indicate approximate efficiency (if known).
5. Provide the following information:

Height - distance above ground to discharge point (feet)
Diameter - inside diameter at discharge point (feet)
Note: if not circular, insert diameter (in feet) of equivalent circular area which can be calculated by

$$D_e = 1.128 \ A$$

where A is the measured or estimated cross-sectional area in sq ft and D_e is the equivalent diameter.
Temperature - at discharge point in °F
Velocity - at discharge point in ft/sec
Flow rate - at discharge in actual cubic feet per minute (ACFM)

Design conditions may be used in lieu of actual test data.

County Permit Number	HC Control Eqmt	Control Eqmt Effic. (%)	Installation Date	Stack Data				
				Height (ft)	Inside Dia. (ft)	Temp (°F)	Velocity (ft/sec)	Flow Rate (ft^3/min)
EXAMPLE P99999	After-burner	95	1969	20	1.5	600	20	2100

Figure 4-1 (cont'd.)

obtained that will allow the agency to apply the correction factors given in Chapter 4 of AP-42. If seasonal adjustments are considered, special emphasis should be given to those variables (e.g., activity levels and temperature) that cause seasonal variations in emissions. (Seasonal adjustment of emissions is discussed in Chapter 7.)

Other information may be solicited in the questionnaires depending on the agency's needs in its oxidant control program. For example, stack data (e.g., stack height and diameter, exhaust gas temperature and flow rates, etc.) may be required for modeling purposes. Fuel characteristics (e.g., sulfur, ash, trace substance, and heat content data) may be desirable, particularly if the questionnaires are being used to obtain information on pollutants other than organics. Certain compliance information may be needed if the agency is utilizing the inventory for enforcement purposes. Information on the nature or brand name of any solvents is particularly helpful to the agency in obtaining species information on organic emissions. Process schematics, flowcharts, operating logs, etc. may be requested to be attached to the questionnaire in cases where the source is especially unique and/or complex. And, of course, each source should be requested to include documented emission estimates or enclose source test results, if available.

An example cover letter/instruction sheet/questionnaire package aimed specifically at obtaining information on solvent users is shown in Figure 4-1. This example exhibits many of the elements required of a questionnaire package. Note that this particular questionnaire will not be generally applicable to all major organic emitting sources; rather, additional questionnaires must be developed to cover refineries, chemical manufacturers, etc. Various example questionnaires dealing with some of the major organic point source categories shown in Table 3-1 are presented in Appendix C to aid the agency in the design of questionnaires for use in a given area. The agency may elect to use the questionnaires in Appendix C without change. Before this is done, however, the agency should carefully consider the objectives that the organic inventory must fulfill in its oxidant and other programs, and then determine if the data supplied in these questionnaires will meet these needs.

Several points should be made regarding the example questionnaires included in Appendix C. First, one is of the general questionnaire type as this is what is frequently being utilized by air pollution control agencies. However, many general questionnaires essentially consist of a package of individual questionnaires, each dealing with a specific type of process such as degreasing, solvent storage, etc. Thus, the agency could use portions of the general questionnaire as industry-specific questionnaires. Moreover, as general questionnaires are often designed for use in a given area having a particular mixture of sources, certain source categories may receive more focus than others in a given questionnaire. The agency should blend components from each questionnaire to best suit the inventory needs in its area as determined from the mailing list or past inventory experiences.

Second, since some facilities are so unique in design and operation as compared to other facilities within the same source category, it is difficult to design questionnaires that can adequately accomodate such differences and still be of manageable size. Thus, segments of some of the example questionnaires are necessarily unformatted, with the plant contact being asked to fill in whatever information he feels is required to describe the source and its emissions. Formatting (i.e., the exact description of what information is needed, the units in which the data should be expressed, and where on the form the requested data should be located) is desirable to the maximum extent possible because it helps avoid confusion both to the person filling out the questionnaire as well as to the agency itself.

Third, while questionnaires are generally a tool used for obtaining point source data, they can be used to collect certain area source data as well. For example, many sources that are sent questionnaires may emit so little that the agency will not want to maintain an individual record on them, but rather, lump them in with an area source category (e.g., small dry cleaning establishments). In addition, questionnaires can be used in certain situations to directly obtain area source information. As an example, suppliers of fuels or some kinds of solvents in an area may be contacted to get the amount of fuel or solvent consumed, collectively, by residential and commercial customers. Several questionnaires of this nature are included in Appendix C, as well. Frequently, area source emissions will be determined through other techniques such as field surveys or the use of information found in special publications. (These other techniques are described in Sections 4.3 and 4.4.)

4.1.4 Mailing and Tracking the Questionnaires and Logging-In Returns

Once the final mailing list has been compiled and the appropriate questionnaire packages are assembled (including mailing label, cover letter, instructions, questionnaires, and self-addressed stamped envelope), the agency should proceed with the mail out activities. The mailing of the questionnaires can be performed in two ways. The first method is by registered mail, which assures the agency that the questionnaire is received by the company. In addition, the rate of response will probably be somewhat greater than if the questionnaires are sent by first class mail. However, this does not guarantee that the company will return the form; thus, the slight increase in response may not justify the added expense of sending every company a registered letter.

The second method is to send the questionnaires by conventional first class mail. This method has proven to be effective if, on the outside envelope, the following expression is clearly printed: "ATTENTION: PLANT MANAGER." This expression directs the envelope to the proper supervisory personnel and reduces the chances of the envelope being discarded. A self-addressed stamped envelope should also be included with each questionnaire as it is more likely to be returned if the postage has already been paid.

Generally, responses will start coming in within a few days after mailing. Many of the early returns will be from companies that are not sources of organic emissions. Also, some of the questionnaires will be returned to the agency by the postal service because either the establishment is out of business or because the company is no longer at that address. New addresses for companies that have moved can be obtained by either looking up their addresses in the telephone book or by contacting an appropriate state or other agency (e.g., the tax or labor departments).

A simple computer program can be helpful in the mailing and logging-in of the questionnaires. Such a program should be designed to produce a number of duplicate mailing labels for each source to which a questionnaire will be sent. One label is attached to the cover letter or instruction sheet of the questionnaire. This facilitates the identification of the questionnaires as they are returned as well as name and mailing address corrections. A second label is attached to the outside of the envelope containing the questionnaire materials. Additional mailing labels may be utilized to recontact those sources whose responses are inadequate and for other administrative purposes. An example label is shown below:

```
XXXX              XXXX
COMPANY NAME,
STREET,
CITY, STATE, ZIP CODE
```

It may be helpful to print the SIC code on the upper left and an assigned identification number on the upper right. The ID number is used to keep records of all correspondence with the company. If the study area is large, a county identification number may also be included on the mailing label.

It is important to develop some sort of tracking system to determine the status of each facet of the mail survey. Such a tracking system should tell the agency which companies questionnaires are mailed to; the dates the questionnaires are mailed and returned; corrected name, address, and SIC information; preliminary information on the nature of the source; whether recontacting is necessary; and the status of the followup contacting effort. (Recontacting is discussed in the next section.) Tracking can be accomplished manually through the use of worksheets or through the use of a simple computer program.

As soon as the questionnaires are returned, some useful analyses can be performed. One activity that can help enhance the timely completion of the mail survey as well as in estimating the amount of resources that will be subsequently needed in the inventory effort, is to classify each response in one of the five categories listed below:

. P - Organic point source
. A - Organic area source
. N - No organic emissions (non-source)
. OOB - Out of business
. R - Recontact for reclassification

In addition, the agency can begin performing emission calculations for those sources that did not supply emission estimates and the resulting source and emissions information can begin to be loaded into the inventory files. (Techniques for calculating emissions are described in Chapter 6.) All responses should then be filed by SIC, source category, geographic location, alphabetically or any other criteria to enable orderly access for further analysis at some later time.

4.1.5 Recontacting

Sources may have to be recontacted by the agency for two basic reasons: the source may not have returned the questionnaire at all or else the response provided may not have been adequate to meet the agency's needs. If the source has received the questionnaire but has not returned it as requested, it can either be encouraged to complete the questionnaire or the information can be obtained in another manner, such as a telephone contact or plant visit. If the source refuses to complete the questionnaire (1) it can either be omitted from the inventory, (2) some sort of crude emission estimate can be made based on activity levels or number of employees (to the extent that this information is known), or (3) if a statute exists requiring a response, legal action can be taken to force a response.

Recontacting activities should begin at an appropriate time (at least four weeks) after the questionnaires are mailed. Recontacting can be accomplished by either telephone or letter. The advantages of recontacting by telephone are that direct verbal communication is involved and, in many cases, lower costs will be incurred (at least when the calls are local). In an average day, one person could possibly recontact up to 30 to 40 companies. Again, caution is urged when making extensive telephone contacts that all Federal, state, or other applicable clearance requirements are observed.

4.2 Plant Inspections

In addition to the mail survey, another technique that is commonly used to gather data for the organic emission inventory involves plant inspections. During a plant inspection, agency personnel usually examine the various processes at a particular facility and interview appropriate plant personnel. If the agency's resources permit, source testing may be conducted as a part of the plant inspection. Because plant inspections are generally much more time consuming than questionnaires, they are usually performed only at the more important point sources.

The plant inspection may represent either the initial contact an agency has with a source, or it can be used as a method of recontacting sources to either obtain additional information or to verify data that were submitted in the questionnaire. In either case, the goal of the plant inspection is to gather data in person from the source that would not be obtained ordinarily through other means. The major advantage of the plant inspection is that it may provide more complete and accurate information about emitters than does the questionnaire alone. In addition, errors are avoided that can result from misinterpretation of the questionnaire or the agency's misinterpretation of the response. Finally, in cases where a process is especially unique and/or complex, the only realistic way for the agency to gain an adequate understanding of the emitting points and variables affecting emissions is to personally observe the plant equipment and go over its operations and process schematics with the appropriate plant personnel. Generally, the agency should make an appointment with the plant personnel before the inspection, especially if the plant has never been visited previously.

The types of data that are acquired in the plant inspection are basically the same as are solicited in a questionnaire. In fact, an option is to actually get together with the plant personnel and fill out the questionnaire that ordinarily would have been sent to the plant. Generally, however, additional data may be obtained than would normally be requested on the questionnaire, such as plant flow diagrams, logs of various process variables, photographs of various emission points, control device characteristics, etc. Naturally, if the plant has source sampled various points in its facility, the test results should be obtained for use in the inventory. Any source test data supplied by a particular plant should be reviewed before it is used in the inventory to make sure that acceptable sampling and analytical procedures have been employed and that the test conditions are reasonably representative of the time period that the inventory is intended to cover.

Special plant inspection forms may be developed to help the agency conduct the plant visit. Because of the extra resources required for development, it is recommended that such forms only be developed when many plant inspections are anticipated, when certain major sources are prevalent, and when the same kind of information will be requested during each visit. This latter condition may not hold in situations where the agency is using the plant inspection as a followup to the questionnaire.

4.3 Field Surveys

A third basic technique for gathering inventory data involves field surveys. The field survey is similar in concept to the plant inspection except that it is primarily a tool for directly acquiring information on certain area sources.

During the field survey, agency employees personally go out into the survey area to determine what sources exist and collect the appropriate process information needed to determine the magnitude of emissions from each source. In addition, the agency may elect to perform a number of source tests to quantify specific emission factors for use in estimating the collective emissions from certain sources.

As an example, the agency may wish to obtain an accurate estimate of organic emissions from agricultural burning in a particular area where this activity is known or suspected to be a major emission source. Rather than rely on permit applications or published data to infer crude estimates of the emissions from this source, the agency could survey a representative sample of farmers, landholders, etc. to determine what is being burned, in what quantities, where and when each material is being burned, etc. In addition, if emission factors do not exist for the burning of certain substances, the agency could (either itself or through the use of a contractor) source test certain kinds of burning activities to develop reliable emission factors. The survey results would have to be extrapolated, of course, to estimate the total burning emissions in the area before the assessment would be complete. Such an extrapolation would necessarily involve developing some sort of relationship between the amount of burning that was observed in the sample and some known indicators such as the amount of each crop produced or the acreage of each crop harvested in the area of concern.

Because direct field surveys are resource-intensive, they should only be considered in specific instances where reliable estimates of organic emissions are needed for certain major area sources and where adequate information cannot be obtained by other, less costly techniques. In many cases, information will exist in available publications, or other agencies will already have compiled a great deal of information on many area sources, which can be used to make sufficiently accurate (or in some cases, more accurate) emission estimates. The best example of this would be motor vehicles. While the agency could conceivably go out and monitor vehicle miles traveled (VMT) on each roadway or selected roadways in an area of concern, state or local transportation agencies very often already have this data or it can be derived from state and local gasoline sales.

Thus, because the field survey is very costly, because some error will still result from extrapolating the survey results to the entire inventory area, and since other techniques often exist that yield adequate or even better emission estimates at much less expense to the agency, it should not be considered a general tool for use in obtaining area source data. Rather, the field survey should be used only in selected instances where it is absolutely necessary. More commonly employed techniques for dealing with certain area sources are described briefly in the next section and in detail in Chapter 5.

4.4 Publications

A fourth approach to obtain inventory data is through the use of information found in selected publications. The term "publication" in this context refers to any industrial or governmental file, periodical, list, etc. that contains information on process descriptions, activity levels, control devices, etc. for various kinds of sources, either individually or collectively. Publications are primarily used to obtain activity level information on area sources, although to some extent, they can also be employed for point sources. The types of reports that are available to employ this technique include census reports, chemical business surveys, marketing reports, trade association journals, energy and fuel consumption reports, etc. Specific examples include various Bureau of Mines publications, the Census of Manufacturers,[9] County Business Patterns,[10] Census of Population,[11] Highway Statistics,[12] and Federal Power Commission Form 67.[13] Frequently, the data reported in these publications will be aggregated at the state or national level and will have to be disaggregated to the area of interest (e.g., to the county level) using various apportioning techniques.

The major area source categories for which publications play an important role in making organic emission estimates include highway vehicles, certain evaporative sources (e.g., gasoline marketing), small stationary sources burning fossil fuels, off-highway vehicles, and certain types of solid waste disposal. Because these several area sources are so important in the organic emission inventory, Chapter 5 is devoted to describing what publications are needed to develop activity level estimates for these sources as well as how the information contained therein can be apportioned in order to obtain emission estimates at appropriate geographical areas (e.g., counties) for use in oxidant control programs.

As mentioned above, publications can be used in certain situations to obtain data on point sources. As an example of this, Federal Power Commission Form 67 contains sufficient data to make crude estimates of organic emissions from fossil fuel-fired power plants. As another example, Post's Pulp and Paper Directory[14] contains equipment and production information with which to estimate emissions from pulp mills. Periodicals such as The Oil and Gas Journal[15] and Chemical and Engineering News[16] intermittently list summary information on individual refineries, chemical manufacturing operations, etc. that can also be utilized to generate emission estimates. In most of these publications, emissions data will not be provided. Instead, emissions will have to be estimated through the use of appropriate activity level emission factors or emission-per-employee factors.

As a rule, emission estimates based on publications should only be used for those point sources where a questionnaire is not received, no plant contact can be made, and for which it is necessary to get individual estimates of an emission potential. In this sense, the use of publications to obtain individual point source data should be considered a default mechanism to be employed only if the other approaches described in this document cannot be used. Often, the most appropriate use of such publications is to help the agency in the development of the point source mailing list. In certain instances, publications can be also useful in determining collective estimates of total capacity, production, number of employees, etc. associated with particular industries. This collective information can aid the agency in scaling up the inventory to account for missing sources. Scaling up is discussed in Chapter 6.

4.5 Other Air Pollution Agency Files

Other potential sources the agency should consider in the data collection phase of the inventory effort include other files that the agency itself (as opposed to other state or local agencies) has compiled. Two types of files in particular are commonly maintained: permit and compliance.

Many states and some local air pollution control agencies maintain various kinds of permit files. Permits may be required of sources at a number of stages during the process of coming on line. Typically, permits will at least be required to initiate construction of a facility as well as when the facility begins to operate. Of importance to the inventory effort is the fact that permit applications generally request enough information about a potential source to get a good idea of the nature of the source as well as an estimate of the magnitude of emissions that will result from its operations. The inventory effort should make use of information in permit files to the maximum extent practical. At a minimum, the permit application file can be used for the development of the mailing list or for determining if a plant inspection or telephone contact is warranted when the source comes on line.

Another type of file that may be maintained by some agencies is the compliance file. A compliance file is a record of the agency's dealings with each source on enforcement matters. For example, a compliance file might contain a list of air pollution regulations that are applicable to a given source, a history of contacts made with the source on enforcement matters, and an agreed-upon schedule for the source to effect some sort of control measures. Because the compliance file will commonly contain basic equipment information as well as baseline emissions data, it can be a useful tool in the inventory effort. Again, at a minimum, each source in the compliance file should be a candidate for the emission inventory if it is not already on the mailing list and especially if its SIC indicates that it is a potential source of organic emissions.

4.6 Existing Inventories

Before the agency elects to employ one or several of the data gathering approaches detailed in the previous sections, it should examine any available inventory that may exist for the particular area of concern. If an inventory for organic materials or any other pollutant has been compiled, and is either well maintained or was initially well documented, many of the data elements therein can be used directly in a new organic emission inventory. In many cases, the existing information can be made current through limited contact with the source, either by telephone, personal visit, or through the use of an abbreviated questionnaire. This is desirable to the extent possible to minimize both the effort that the source and the agency must expend in updating the inventory data base.

One point should be stressed when this approach is employed. If the existing inventory that is used as a starting point in the current effort was not conducted primarily for organic compounds, there may be a number of major organic emitting sources that may either be omitted from such an inventory or treated collectively as area sources because their emissions of some other pollutant(s) are negligible. Hence, the agency should consider the possibility that additional sources may have to be included. Conversely, there may be many sources in an existing inventory that are considered major sources of some other pollutant but not necessarily of organics. Caution should be taken in this latter instance that a significant quantity of resources allocated for the organic inventory are not expended in soliciting additional information from those sources that are not significant organic emitters.

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Chapter 5

SPECIAL AREA SOURCE DATA COLLECTION PROCEDURES

Point sources are generally larger facilities for which individual records are developed and maintained in the inventory. On the other hand, area sources are generally small and/or numerous activities for which collective source and emissions information is maintained. In some cases, large sources may inadvertantly and necessarily be handled as area sources if no individual source and emissions data are available for them.

Information can be collected on some area sources by employing the point source procedures outlined in Chapter 4. However, certain important area sources of VOC are so small and so numerous that standard point source procedures cannot be applied because of time and cost. Instead, special procedures are used for developing collective estimates of their activity and the emissions associated with them. Generally, the most important of these area sources in many urban areas is highway vehicles. Other important area sources that are usually considered collectively include off highway vehicles, certain kinds of evaporative sources, small stationary sources burning fossil fuels, and some types of solid waste disposal.

Generally, the most important parameter for estimating area source emissions is the collective activity level for each area source category. An activity level is any parameter associated with the activity of a source (e.g., production, fuel consumption, etc.) that may be correlated with the air pollutant emissions from that source. For example, the number of landings and takeoffs (LTO's) provides an estimate of aircraft activity that can be used to estimate emissions from an airport. In this example, the number of LTO's can be multiplied by appropriate emission factors from AP-42 to estimate airport emissions. As another example, the total amount of gasoline handled by service stations in an area can be used to estimate evaporative losses from gasoline marketing. In this case, the gasoline handling activity can be multiplied by an emission factor representing all of the individual handling operations at each service station in order to estimate total emissions from this source category. Hence, because of their important role in developing area source emission estimates, reliable techniques are necessary for estimating activity levels.

This chapter presents various methodologies for estimating activity levels, and in turn, emission estimates, for the more important area sources of VOC. While the primary emphasis is given to the determination of activity level information, some discussion is provided on how the emission estimates are made and other parameters that are needed. A more specific discussion of making emission estimates for both point and area sources is included in Chapter 6. For many area source categories, several alternative methodologies are presented for estimating activity levels. In general, those approaches that utilize locally available data (such as questionnaires or field surveys) usually result in the most accurate emission estimates. If local data are not available or cannot be determined through these techniques, "default" procedures are described that allow activity levels, and in turn, emission estimates to be made by apportioning (disaggregating) statewide and nationwide data available from various publications to the local level. These various apportioning techniques can be quite tedious and require that the agency have access to numerous publications.

EPA uses the publications-based techniques described in this chapter for estimating area source emissions at the county level for inclusion in NEDS. Those interested in obtaining NEDS emission estimates for particular area sources in specific counties should contact their EPA Regional Office or the National Air Data Branch, Research Triangle Park, N.C. 27711. In general, these NEDS area source estimates will not be as sensitive to local conditions as estimates made by an agency using locale-specific information.

5.1 Mobile Source Fuel Use

Mobile source fuel use includes highway use (automobiles, trucks, buses, etc.) and non-highway fuel use (railroads, vessels, aircraft, and miscellaneous other off-highway vehicles). Since these sources (especially automobiles) account for the majority of organic emissions in many urban areas, it is vital to obtain accurate estimates of mobile source activity. Emission estimates for mobile sources are made in two basic ways. The preferred approach is to obtain a measure of the activity that is directly compatible with the emission factors given in AP-42 for each source category. For example, since emission factors for highway vehicles are expressed in terms of the weight of organics emitted per unit of distance traveled (e.g., gm/mile), it is best to measure vehicle miles traveled (VMT) by all vehicles in an area. As another example, rail locomotive emission factors are expressed in terms of the weight of organic emitted per volume of fuel oil consumed (e.g., lb/10^3 gallons). Hence, a measure of the fuel consumption by all locomotives in an area yields the most accurate estimate of emissions from this area source.

Oftentimes, a direct measure of the most appropriate parameter is not available to an agency. In these cases, surrogate parameters have to be used to estimate emissions. For example, VMT can be estimated from the quantity of fuel used in an area. Similarly, the quantity of locomotive fuel oil consumed can be estimated based on the number of miles of track in an area.

Techniques for directly collecting appropriate activity levels for the most important mobile sources are given the following pages. In addition, various techniques are presented for estimating these activity levels using surrogate indicators as well as for apportioning the resulting estimates to the local level.

5.1.1 Highway Motor Vehicles

Highway motor vehicles represent the largest single source of volatile organic emissions in many urban areas. Highway motor vehicles are grouped according to the following classifications:

1. Light-duty automobiles
2. Light-duty trucks
3. Heavy-duty gasoline-powered vehicles
4. Heavy-duty diesel-powered vehicles
5. Motorcycles.

In the above classifications, light-duty automobiles are those under 6,000 pounds gross vehicle weight, light-duty trucks are those under 8,500 pounds, and heavy-duty vehicles are those over 8,500 pounds.

To properly calculate emissions for highway motor vehicles, measured or estimated travel (i.e., VMT) for each vehicle category should be determined. However, because light-duty diesel and LPG-powered vehicles are usually of lesser importance from an emissions standpoint, it is generally sufficient and much simpler to consider only three categories: all light-duty gasoline powered vehicles, heavy-duty gasoline, and heavy-duty diesel powered vehicles. The techniques outlined in the next several pages on highway vehicles all employ this simplifying assumption. Those interested in more detailed estimates that consider all of the above vehicle categories should contact EPA's Office of Transportation and Land Use Policy, 401 M St., SW, Washington, D.C. 20460.

5.1.1.1 Measured VMT

If at all possible, total measured vehicle-miles of travel (VMT) should be obtained in the survey area. Total VMT are often available from traffic surveys conducted by state highway departments or local transportation agencies. These agencies must be contacted personally to determine what kinds of traffic data are available and in what formats for use in the motor vehicle inventory. VMT data are best obtained by vehicle category. Total VMT includes diesel VMT as well as gasoline VMT.

If actual vehicle-mile information is not available from these surveys, VMT may be estimated from traffic counts or traffic flow maps. This is accomplished by multiplying the traffic volume on a specific road by the length of the roadway. Since the highway vehicle emission factors in AP-42 vary appreciably with average speed, VMT data should be obtained by roadway classification. On the basis of average speed, roadway types can be classified as limited access (greater that 50 mph), suburban roads (35 mph), and urban streets (25 mph or less).

Once measured VMT data have been compiled for the survey area, the appropriate emission factors and correction factors should be used to calculate emissions from each vehicle category. To enhance the accuracy of the inventory, the agency may wish to develop locale-specific correction factors as well as VMT. For example, the agency should determine what temperatures are representative of the time interval of interest, and apply the appropriate correction factors corresponding to these temperatures. Other correction factors account for variations in percent hot- vs. cold-mode operation, altitude, vehicle load, speed, etc. Appropriate emission factors and correction factors for use in base line inventories are presented in AP-42. Because AP-42 is revised periodically to reflect additional mobile source test data, the agency should contact EPA's Office of Transportation, Land Use, and Planning, (401 M St. SW, Washington, DC 20460) for the most appropriate emission and correction factors for highway vehicles.

5.1.1.2 Estimated (Calculated) VMT

If measured VMT are not available, or if the inventory needs do not justify the expense of collecting this kind of data, VMT can be calculated on the basis of estimated fuel use in the survey area. The use of VMT based on areawide fuel use data will usually result in less accurate estimates of motor vehicle emissions than will the use of directly measured VMT. This is because actual VMT are a complex function of the geographical characteristics of the area; the proximity of large population centers, employment centers, or tourist attractions; transportation system characteristics (whether an interstate highway is present, whether mass transit systems exist, etc.), and other factors; none of which are easily related to fuel use or any other parameter than VMT.

Several alternatives are available to develop fuel use estimates. The most accurate is to obtain local fuel use data for the specific survey area. For example, some states or local agencies may be able to provide fuel use data directly for specific locales. If county or local data are not available, a simplified, but less accurate procedure is to apportion total state fuel use (available from Highway Statistics[1] if not directly available from an appropriate state agency) to the county level based on county gasoline sales reported by the state tax department or by published information such as is found in the Census of Business.[2] Another less accurate technique is to apportion total state fuel use to the county level based on the population of each county, as determined from the Census of Population.[3] In either case, the basic apportioning formula has the following form:

$$\text{County sales} = \text{State sales} \times \frac{\text{County service station sales (or population)}}{\text{State service station sales (or population)}}$$

Once county or local fuel use totals are obtained, VMT can be calculated for both gasoline- and diesel-powered vehicles. County gasoline VMT can be estimated by dividing county gasoline fuel use by 12.2 miles per gallon.[1] This is then apportioned into heavy-duty and light-duty vehicle-miles by assuming approximately 11 percent[1] of the total miles in the county are heavy-duty travel. The resulting totals may then be distributed into urban and rural fractions using the percentages given, by county, in the Census of Population. County diesel VMT are estimated similarly except a figure of 5.1 miles per gallon[1] should be used for estimating VMT from county diesel fuel use.*

Once VMT for both highway classes are known, volatile organic compound emissions are calculated using the technique discussed in the preceeding section. Again, the Office of Transportation, Land Use, and Planning should be consulted so that the appropriate emission factors and correction factors are applied that best represent the survey area.

5.1.1.3 Estimated VMT Using State and Nationally Aggregated Data

If measured VMT are not available, and local fuel-use estimates cannot be made for the survey area, an alternative technique for estimating VMT is to use procedures that employ state and nationally aggregated data. The following method first estimates VMT for each major vehicle category on a statewide basis, and then apportions these statewide totals to the county level. The agency must have available a number of publications in order to calculate VMT for a given area using this approach.

State Gasoline and Diesel - HDV

Four heavy-duty vehicle (HDV) truck categories are defined:

HDV_1	6,000 - 10,000 lbs
HDV_2	10,000 - 20,000 lbs
HDV_3	20,000 - 26,000 lbs
HDV_4	Greater than 26,000 lbs

In order to obtain the total motor fuel consumed by all HDV categories in each state, the following calculation is performed:

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*The most current mileage estimates from Reference 1 should be considered for estimating gasoline and diesel VMT from fuel use data.

$$\text{Motor fuel for HDV} = \sum_{i=1}^{i=4} (\text{HDV}_i \times \text{average miles}_i/\text{miles per gallon}_i) + \text{commercial buses} \times 7276 \text{ gallons per bus} + \text{school buses} \times 1058 \text{ gallons per bus}$$

The breakdown of trucks into the four weight categories is available from the Census of Transportation[4] (published every five years), or from R.L. Polk[5] in Detroit, Michigan. Average miles traveled by weight category are taken from the Census of Transportation and are held constant over the five years following that census. Upon publication of the new Census of Transportation, these averages must be updated. Miles per gallon figures by weight category are derived from the Road User and Property Taxes,[6] a triannual publication of the Federal Highway Administration.

Recent averages for each HDV category are:

HDV_1 = 11.2 miles/gallon
HDV_2 = 8.5 miles/gallon
HDV_3 = 7.2 miles/gallon
HDV_4 = 5.5 miles/gallon

Data on buses are obtained from both the Federal Highway Administration[1] and the Automobile Manufacturers Association.[7] Once total motor fuel consumed by HDV's has been calculated for each state, gasoline usage by HDV's is obtained by subtracting total diesel and butane use from the motor fuel figures for each state. Diesel totals for HDV's are estimated annually by the Federal Highway Administration.

County Gasoline and Diesel - HDV

County use of diesel fuel by HDV's is obtained by using county truck registrations as the apportioning factor to be applied to total fuel used by HDV's in the respective state.

$$\text{Diesel HDV}_{\text{county } i} = \frac{\text{trucks} > 6000\ \text{lb}_i}{\text{trucks} > 6000\ \text{lb}_I} \times \text{diesel HDV}_{\text{state } I}$$

In order to calculate the county use of gasoline for HDV's, the county-by-county R.L. Polk truck registrations by weight categories are used. If these data are not available, county registrations of trucks by weight categories are estimated by assuming that the proportion of registrations in each category is the same for all counties within a state. Of course situations arise where fuel is sold in one area and utilized in another, and the agency may wish to make certain adjustments based on its experience and judgement. The remaining calculation is similar to that used to obtain the state totals for this category:

$$(\text{gasoline HDV})_{\text{county } i} = \sum_{j=1}^{j=4} \text{HDV}_j \times \text{avg miles}_{j(I)}/\text{MPG}_j(I)$$

$$+ \frac{\text{population (census yr)}_i}{\text{population (census yr)}_I} \times \text{commercial buses} \times 7276\ \text{gal/bus}$$

$$+ \frac{\text{population (census yr)}_i}{\text{population (census yr)}_I} \times \text{institutional buses} \times 1058\ \text{gal/bus}$$

$$- \frac{\text{trucks}_i}{\text{trucks}_I} \times (\text{diesel \& butane})_I$$

State Gasoline - LDV

State LDV gasoline use = Total gasoline sales for highway use minus HDV Gasoline use

County Gasoline - LDV

The method developed for county allocation of gasoline use by LDV's is as follows:

a. If vehicle miles are available by county they are to be used as the distributive factor in the form:

$$\text{gasoline LDV}_{\text{county}_i} = \frac{\text{vehicle miles}_i}{\text{vehicle miles}_I} \text{ x total gasoline}_{\text{state I}}$$

$$- \text{ gasoline HDV}_i$$

b. If vehicle mile data by county are not available, the sum of the registered automobiles and trucks under 6,000 lbs in each county[5] is adjusted by means of a rural/urban miles per vehicle index and used as the distributive factor in the form:

$$\text{gasoline LDV}_{\text{county i}} = \frac{\text{LDV}_i \text{ x index}_i}{\overset{i=n}{\underset{i=1}{\Sigma}} = (\text{LDV}_i \text{ x index}_i)} \text{ x total gasoline}_{\text{state I}}$$

$$- \text{ gasoline HDV}_i$$

where state i consists of n counties.

The appropriate miles per vehicle indices are as follows:[8]

Population % Rural	Index
0-25	67
26-50	87
51-75	103
76-100	115

Using the above indices to adjust county LDV registrations roughly accounts for vehicles in rural areas traveling a higher number of miles than vehicles in urban areas. The indices represent the averages for selected states where measured VMT are available. Since driving patterns may vary considerably from one state to another, the indices may be less accurate for some states than others.

Once VMT are calculated in this manner, they should be applied to the appropriate emission and correction factors to estimate emissions for the survey area.

5.1.2 Aircraft

Emissions of volatile organic compounds from aircraft are not nearly as important as from highway vehicles, but can be significant in certain areas. Aircraft emissions are generally based on the number of landing and takeoff (LTO) cycles performed. It is simpler and more meaningful to collect LTO data from airports than fuel consumption. Each landing or takeoff by an aircraft is an operation. An LTO is comprised of one landing and one takeoff by an aircraft, or operations divided by two. Emissions from aircraft are commonly divided into three categories: commercial, general, and military.

Several approaches can be followed for estimating LTO's in an area. The preferred approach is to obtain information directly from each airport. Very often airports will have detailed information available on their operations that can be helpful to the agency. A questionnaire, such as is included in Appendix C (Section C-3), can be used for directly acquiring LTO and other useful information from airports in the survey area. For commercial airports, questionnaire data can be supplemented by published references. Airline schedules, such as given in the Official Airline Guide,[9] report the type of aircraft for each flight. Airport Activity Statistics of Certified Route Air Carriers[10] reports aircraft departures performed in scheduled service by aircraft types. This latter reference also gives a listing of aircraft types which may be useful in classifying commercial aircraft according to the categories listed above.

Aircraft emission factors in AP-42 are presented both in terms of the quantity of organics emitted per LTO cycle (which includes all normal operation from the time the aircraft descends through 3,500 feet in altitude on its approach and the time it subsequently reaches 3,500 feet in altitude after takeoff) and the quantity of organics emitted per hour in each mode of operation during the LTO. Generally, the LTO averaged factors will be applicable in most inventory situations. However, where detailed aircraft data are available on the time spent by each aircraft in each LTO mode (e.g., taxi-idle, takeoff, etc.), the modal emission factors should be applied. Both kinds of factors are described in Chapter 3 of AP-42.

If LTO activity cannot be directly obtained from each airport, Federal Aviation Administration publications may be used to determine LTO cycles performed, as shown below:

1. FAA Air Traffic Activity:[11] This publication gives the number of operations performed by commercial, civil, and military aircraft at airports with FAA-regulated control towers. These airports will include all the major nonmilitary airfields in the United States. Totals are given for itinerant flights,

i.e., those that terminate at an airport different from the one at which they originated, and for local flights, i.e., those that terminate at the same airport. To determine total LTO's for each aircraft category, the sum of itinerant and local operations should be used.

2. Military Air Traffic Activity Report:[12] This publication gives the number of operations by military and civil aircraft performed at military airfields. The above procedure is followed to determine LTO's.

3. Census of U.S. Civil Aircraft:[13] This publication can be used to obtain rough estimates of the number of LTO's performed by civil aircraft at airports that do not have FAA-regulated control towers. These airports include smaller public airports and privately owned airstrips. The Census of U.S. Aircraft gives the number of active civil aircraft in each county. These data can be used to estimate LTO's by assuming that the total number of eligible aircraft in each county is approximately equal to the number of daily LTO cycles performed by civil aircraft. This method should be used to estimate LTO's only for airfields not included in Reference 11.

Use of the above references will give the number of LTO cycles according to civil, commercial, and military classifications. By assuming the mix of aircraft types included in each category, average emission factors can be developed to compute the emissions for each category. This approach is generally acceptable for civil aircraft. However, for detailed emission inventories it may be desirable to break down commercial and military LTO's according to the type of aircraft. By identifying LTO's according to the classifications given in AP-42, Compilation of Air Pollutant Emission Factors, emissions may be computed which account for the aircraft mix in a certain area.

5.1.3 Railroads

This source category includes two types of activity: railyard switching and road-haul service. Railroad locomotives are not a major source; however, significant amounts of VOC can be emitted in certain local areas from a concentration of railroad activity, such as is associated with large switchyards. Emissions are estimated based on the total amount of fuel oil used by locomotives in an area or their total work output. Both techniques described below estimate emissions based on fuel use.

The preferred approach is to contact the railroad companies for information on state or county fuel use. Generally only state totals will be available. A less accurate alternative is to utilize Bureau of Mines data from Mineral Industry Surveys[14] to estimate state fuel usage of fuel oil by locomotives.

State fuel use can be apportioned to each county on the basis of miles of track per county, as determined from detailed state maps, or obtained from the rail lines. If state maps are employed, the track mileage should be doubled in counties exhibiting significant railyard operations. This is because operations, and hence, emissions in rail yards are usually greater than on main-line track, which is not determined from the use of maps. An alternative and less accurate apportioning approach is to distribute state fuel totals on the basis of county population as given in the Census of Population. The population apportioning technique should be used only when it is impossible to obtain track mileage data. This technique assumes that most yard operations take place in large cities.

Residual oil, which may be used by railroads in addition to diesel fuel oil, can be accounted for if Bureau of Mines figures are used by adding the state residual oil total for railroads to the distillate oil total before apportioning to counties. The use of coal by railroads can be considered negligible and does not need to be considered.

Once fuel oil consumption by locomotives is determined for the survey area, the appropriate emission factors from Chapter 3 of AP-42 should be used to estimate organic emissions. Generally, the average factors in AP-42 should be used unless specific information is available on each engine type in an inventory. An example questionnaire for collecting railroad activity is included in Appendix C, Section C-3.

5.1.4 Vessels

This source category includes ocean-going ships, river vessels, and small pleasure craft used on lakes and rivers. Emissions are determined for vessel travel (and dockside operations) by estimating the quantity of fuel used by each kind of vessel in the survey area. Vessels are generally a minor source of VOC emissions, but may be included in a detailed inventory in certain areas where vessel traffic is heavy or where docking activity is considerable. A detailed discussion of each type of vessel and the methods used to obtain fuel consumption data are presented below.

1. Coal-powered vessels: A few vessels, notably in the Great Lakes region, still burn anthracite coal. No reliable methods are available for estimating emissions on a local basis for these vessels because only nationwide fuel totals are available.[15] Thus, information on local fuel consumption can be obtained only from estimates made by port authorities or ship operators.

2. Gasoline-powered vessels: This category includes small pleasure craft operated on lakes, rivers, and coastal areas. Most of these craft are powered by outboard motors, but inboards and inboard-outdrives using gasoline are also included. Gasoline use for states may be estimated as followed:

   Inboard gasoline = # registered inboards x 3 gal/hr x 10 C hr/yr
   Consumption (gal/yr)

   Outboard gasoline = # registered outboards x 1.5 gal/hr x 10 C hr/yr
   Consumption (gal/yr)

   The factor C is a climatic factor which accounts for a longer pleasure boating season in warmer areas. C is the number of months during which the monthly mean temperature exceeds 45°F for counties north of 43° latitude, 48°F for counties between 37° latitude and 43° latitude, and 55°F for counties south of 37° latitude. State boat registrations are obtained from a boating industry publication,[16] but should also be available from the state agency responsible for boat registrations. Vessels powered by inboard-outdrives are included with inboards to estimate fuel use. The fuel use factors are derived from Reference 17.

After state totals are obtained they can be apportioned to counties by county inland water surface area[18] modified to include a surface area for coastal regions where necessary. Apportioning to counties is the chief area in which the standard method could be improved by local input. Using knowledge of where boating activity actually takes place will provide more accurate county totals than apportioning to counties only on the basis of water area. Boat registrations by county, if available, may be useful, but boats are not necessarily used in the county in which they are registered in all states. Reference 18 is also deficient in that any man-made reservoirs constructed since 1960 are not included. The method for accounting for vessel use in coastal areas is very poor, and could be improved upon tremendously by local input.

3. Fuel oil (including diesel) powered vessels: Fuel consumption by these vessels, which represent the major subcategory of interest, includes the fuel used by large cargo and passenger ships, oil tankers, tugboats, and all other steamships and motorships that use fuel oil. Fuel consumption totals can be obtained by:

   a. Questionnaire surveys of shipping and tugboat companies and contact with the local port authorities. This method provides the most accurate local data for fuel consumption rates of many of the vessels in the area. Such a survey is not often comprehensive enough to include all vessels, however, because many vessels move in and out of the port area during the year and would be difficult to contact.

b. Vessel movement data available from the U.S. Corps of Engineers,[19] together with fuel consumption factors and Bureau of Mines fuel consumption figures.[14] This method is much easier to implement than a questionnaire survey, and may be almost as accurate despite the generalizations that must be made to effect its use. This method is described in detail later.

c. Use of Bureau of Mines figures only. State totals for fuel oil sold to vessels are given in Reference 14. Not all the fuel sold for vessel use is by any means consumed within the state boundaries, however. Much of the fuel may be consumed far out at sea and not in a port or waterway area. If it is assumed that 75 percent of the distillate oil figure given in Reference 14 and 25 percent of the residual oil total are consumed in ports and waterways within the state, a rough estimate of vessel fuel oil consumption can be obtained. This method should not be used in conjunction with a detailed emission inventory, however, and is useful mainly to obtain an order-of-magnitude emission estimate from vessel operations.

If fuel consumption totals are determined from a questionnaire survey, the fuel oil consumption figures should simply be assigned to the counties where the vessels are operated. If vessel movement data obtained from Reference 19 must be used, extensive apportioning measures are necessary. The apportioning method becomes somewhat involved because both underway and dockside emissions should be considered. Underway and dockside emissions include the emissions that occur when a vessel is moving under its own power through a waterway and when it is maneuvering into its dock space. Average fuel consumption rates during these periods for steamships and motorships are 44 and 19 gallons per nautical mile, respectively.[20] In-port, or dockside, emissions occur when a ship operates its engines or boilers when in port to provide power for the ship's utilities. Average fuel consumption rates are 1900 gallons per day of residual oil for steamships and 660 gallons per day for motorships.[20] The local port authority should be able to supply a figure for the number of days, on the average, that a ship remains in port. If not, an average figure of 3 days per vessel is typical.

Fuel consumption can be estimated from vessel-movement data for fuel oil-powered vessels as follows:

Step 1: Determine in-port fuel consumption.

1. The number of vessels entering a port can be found in Section 2 of parts 1, 2, 3, and 4 of the Waterborne Commerce of the United States.[19] Section 2 lists vessel traffic on waterways for self-propelled vessels and non-self-propelled vessels according to type and draft of vessel and direction of trip. For the first step in the determination of in-port emissions, select the entries for ports in Section 2, and assume that only self-propelled vessels with a draft greater than 18 feet will be operating under their own power when in port. Determine the number of vessels meeting these conditions that enter each port, and multiply by 3 days per vessel or by a number recommended by the port authority to calculate the number of vessel-days in each port.

2. Vessel-days in port must be distributed between those ships that use residual oil and those that use distillate (diesel) oil. This procedure is illustrated as follows:

   a. From Reference 14 determine the amounts of distillate and residual fuel oils sold for use by vessels in each state. Example fuel and sales for a particular state are given below:

      Distillate oil consumption = 232×10^3bbl = $9{,}750 \times 10^3$ gal

      Residual oil consumption = $1{,}000 \times 10^3$bbl = $42{,}000 \times 10^3$ gal

      Convert fuel consumption figures to vessel-days:

      $$\text{Distillate vessel-days} = \frac{9{,}750 \times 10^3 \text{ gal}}{660 \text{ gal/day}} = 14{,}800 \text{ vessel-days}$$

      $$\text{Residual vessel-days} = \frac{42{,}000 \times 10^3 \text{ gal}}{1{,}900 \text{ gal/day}} = 22{,}100 \text{ vessel-days}$$

   c. Then total vessel-days = 14,800 + 22,100 = 35,900 vessel-days

      $$\text{Percent distillate vessel-days} = \frac{14{,}800}{36{,}900} \times 100\% = 40\%$$

   d. Then at each port in this state, assign 40 percent of the total vessel-days to motorships (diesel fuel users) and 60 percent to steamships (residual fuel users).

3. Finally, in-port fuel consumption can be calculated by multiplying the total distillate oil vessel-days by 660 gallons per day, and the total residual oil vessel-days by 1900 gallons per day.

Step 2: Determine fuel consumption for vessels underway:

1. Underway emissions will be calculated for diesel fuel use only. In a typical harbor there are tugboats and small craft (draft less than 18 feet) that use diesel fuel. Because most of these do not

operate their boilers or engines when in port, most of the emissions occur when the ships are underway. Vessels using residual oil also have underway emissions, which are approximately accounted for when emissions for vessels using diesel fuel are calculated by the technique described below.

2. Calculation of underway fuel consumption:

   a. Subtract the sum for all ports of the in-port diesel fuel consumption from the state total for distillate oil consumption by vessel as given by Reference 14.

   b. Distribute the remaining fuel consumption figures to ports and waterways according to tonnage handled, as given in Section 1 of Waterborne Commerce of the United States. Underway fuel consumption totals are assigned to counties using the description of the waterway given in Waterborne Commerce of the United States. In cases where a waterway borders more than one political jurisdiction, divide the fuel use equally between jurisdictions. In instances where a waterway, such as a river, passes by a series of counties, assign the emissions to counties according to shoreline mileage along the waterway.

It should be noted that two methods have been given that can be used for a detailed survey of fuel oil use by vessels. As mentioned previously, Bureau of Mines data alone are useful only for a rough guess of vessel fuel oil use. Little can usually be gained by using both of the methods for fuel oil consumption by vessels. Vessel-movement data serve as replacements for questionnaires or vice versa. A modified version of the vessel-movement data method would be to contact port authorities for the vessel-movement data. The Waterborne Commerce of the United States data are much more complete, however, and should be used if at all possible. All four parts of Waterborne Commerce of the United States are not necessary for completion of a vessel fuel use inventory. Only that part that covers the geographic area being considered need be used. The choice of either of the first two methods depends on whether sufficiently complete data could be obtained by a questionnaire survey to justify the time required to institute the survey. If detailed data for individual types of vessels such as tugboats, tankers, and cargo ships are desired, questionnaires should be used. If only a reliable estimate of the total fuel consumption by vessels is desired, vessel-movement data are adequate.

Once fuel consumption data are available, emissions can be calculated for each class of vessel using appropriate emission factors in Chapter 3 of AP-42. If extremely detailed data are available for fuel consumption as a function of operating mode, the more detailed procedures and emission factors prescribed in AP-42 can be employed.

5.1.5 Other Off-Highway Fuel Use

Off-highway internal combustion engines are both gasoline- and diesel fuel-powered. The first category includes farm tractors, lawnmowers, motorcycles, snowmobiles, etc. The latter category includes farm tractors, construction equipment, emergency generator power units, compressor engines, etc. While each of these source categories may be relatively small in many areas, their collective emission rates can be significant.

Because snowmobile activity does not correspond with the oxidant season, the agency may consider ignoring this minor category in its inventory effort. Some of the other categories, however, such as tractors, lawnmowers, construction equipment, etc. may be relatively more active during the oxidant season. For many of these source categories, emissions are calculated based on the amount of fuel used by each type of equipment.

The following procedures allow emission estimates to be made for these sources based on information found in publications and national average conversion factors. Locale-specific techniques are not available for estimating emissions from these sources; however, to the extent that local fuel use data are available, (or even locally-derived conversion factors for use in the following equations), they should be used in the emission calculations presented below.

5.1.5.1 Motorcycles

Gasoline use is estimated by assuming that on the average, motorcycles achieve 42.5 miles per gallon and travel about 700 miles/year off-highway. Using these conversion factors, state motorcycle registrations (available from Reference 1) can be apportioned to the county level on the basis of population, as follows:

$$\text{County Consumption (gal/yr)} = \text{State Registrations} \times \frac{\text{County Population}}{\text{State Population}} \times \frac{700 \text{ miles/yr}}{42.5 \text{ miles/gallon}}$$

County fuel consumption is then multiplied by the appropriate emission factors in AP-42 to estimate local emissions. In the above equation, if local mileage, fuel efficiency, or county registration data are known, they should be used to estimate county consumption.

5.1.5.2 Farm Equipment

Farm tractors account for the bulk of the activity in this category, with lesser amounts of fuel being used by combines, balers, harvesters, and general utility engines used for irrigation and miscellaneous purposes. Both gasoline and diesel fuel may be consumed by farm machinery.

State consumption of gasoline and diesel fuel for each category is determined as follows:

$$\text{Consumption (gal/yr)} = \text{Equipment population} \times \text{Usage (hr/yr)} \times \text{Fuel rate (gal/hr)}$$

Equipment populations and use factors can be obtained either from the Census of Agriculture[21] or derived from data shown in Table 5.1-1 below. County consumption of each fuel is determined by apportioning the state total for all farm equipment to counties according to number of farm tractors in each county.

Table 5.1-1. USAGE RATES, CONSUMPTION RATES, AND POPULATION DISTRIBUTION FOR HEAVY-DUTY AGRICULTURAL ENGINES[17]

	Annual Usage (Hr/Yr)	Fuel consumption Rate (gallons/hour)		Population Density (percentage)	
		Gasoline	Diesel	Gasoline	Diesel
Combines	71	2.34	1.5	57	43
Balers	24	2.34	1.5	100	0
Harvesters	120	2.34	1.5	0	100
General Purpose	50	3.51	1.94	50	50
Tractors	*	2.28	2.98	65	30**

*490 hr/yr Diesel, 291 hr/yr Gasoline

** About 5% is LPG which is not included here.

5.1.5.3 Construction Equipment

County gasoline and diesel fuel use are determined as follows:

$$\text{County Consumption} = \text{National Fuel Use} \times \frac{\text{State Employment for SIC 16} \times \text{County Population}}{\text{National Employment for SIC 16} \times \text{State Population}}$$

National average usages of gasoline and diesel fuel are shown in Table 5.1-2 below.

Table 5.1-2. NATIONAL FUEL ESTIMATES FOR 1973, GALLONS[17, 22]

	Gasoline	Diesel
Construction Equipment	423×10^6	$4{,}453 \times 10^6$
Industrial Equipment	$944{,}162 \times 10^3$	$1{,}064{,}705 \times 10^3$
Lawn and Garden	$583{,}467 \times 10^3$	---
Snowthrowers	$17{,}504 \times 10^3$	---
Snowmobiles	$82{,}593 \times 10^3$	---

Employment data are available from Reference 23 and population data from Reference 3. If local fuel use is known, it should be used to enhance the accuracy of the resulting emission estimate.

5.1.5.4 Industrial Equipment

County gasoline and diesel fuel used by industrial equipment (forklifts, generators, pumps, miscellaneous machinery) are computed as follows:

$$\text{County Consumption} = \text{National Fuel Use} \times \frac{\text{County Employment for SICs 10-14,20-39,50,51}}{\text{National Employment for SICs 10-14,20-39,50,51}}$$

National fuel use data are available in Reference 17. Employment data are available in Reference 23. Local fuel consumption data or apportioning factors should be used when known for the area.

5.1.5.5 Lawn and Garden Equipment

Gasoline use by lawn and garden tractors, mowers, tillers, and snowthrowers, is calculated for each county based on national fuel use data from Reference 17. National fuel use is apportioned to counties on the basis of number of single unit dwellings,[24] number of days per year for which the minimum temperature is greater than 32°F, and county snowfall.[25] Number of single unit housing structures is the primary apportioning factor and the latter items adjust for the extent of summer- vs. winter-related uses. The appropriate equation for apportionment of fuel use is:

$$\text{County Consumption} = (\text{National lawn and garden consumption})$$

$$\times \frac{(\text{County unit structures})}{\text{National unit structures}} \times \frac{(\text{Days min. temp.} > 32^{0}\text{, County})}{\text{Days min. temp.} > 32^{0}\text{, Nation}}$$

$$+ C_1 \times (\text{National snowthrower consumption} \times \frac{\text{County Population}}{\text{Snow Zone Population}}$$

$$\times \frac{\text{County Snowfall}}{\text{Snow Zone Snowfall}}$$

Where - National lawn and garden consumption is the national gasoline consumption of lawn and garden equipment other than snowthrowers.

- Days min. temp > 32^0, Nation is the sum of the totals for all counties in the nation.

- C_1 = 0 for counties with less than 30 inches annual snowfall,
  C_1 = 1 for counties with more than 30 inches annual snowfall.

- Snow zone population and snow zone snowfall are the sums of population in all counties with more than 30 inches of snowfall, and the sum of snowfalls in all counties with more than 30 inches of snowfall.

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5.2 Solvent Evaporative Losses

Evaporative losses represent a major source of organic emissions in many areas. Some of these sources, such as dry cleaning, degreasing, surface coating operations, and service stations are best accounted for by using the point source methodologies described in Chapter 4. However, collecting data on all of these sources individually may not be possible in some areas because of data availability and resource constraints; hence, techniques are presented below for providing collective emission estimates for these sources.

Other evaporative sources, such as cutback asphalt paving and pesticide application, are generally treated exclusively as area sources. To the extent that techniques are available for inventorying these sources, they are described below, as well.

Emission estimates from most evaporative sources are made assuming complete loss of solvent during or subsequent to its use or application. This is not believed to be the case with cutback asphalt and may not hold for pesticide applications, either. This is also discussed in the following sections.

5.2.1 Gasoline-handling losses

Gasoline-handling losses include evaporative losses from gasoline marketing operations, i.e., filling losses from loading underground storage tanks at service stations, and spillage and filling losses from pumping gasoline into automobile gas tanks. Bulk tanks are generally considered as point sources. Questionnaires may be sent to service stations in order to obtain data on each one. An example questionnaire for this source category is included in Appendix C. However, because they are generally so numerous in most (especially urban) areas, and since emissions from each one are fairly low, service stations are often handled as area sources.

Emission estimates from service stations are based on the amount of gasoline handled; hence, the agency should obtain data on gasoline distribution in the area of concern. The best approach to do this is to develop an overall flow chart depicting gasoline flow within the geographical area in question from its point of entry, through bulk storage, to service stations and vehicle loading operations. An example gasoline flow chart is shown in Figure 5.2-1. The information to develop this chart is obtainable from such local sources as associations of service station owners and operators and oil company distributers and jobbers. Additional data may be obtained from Federal, state, and local governmental energy agencies, the Federal Highway Administration,[1] and the state department of revenue. Examples of specific references which provide data on the distribution or sales of gasoline are Waterborne Commerce of the U.S.[2] and Bureau of Census, Service Station Sales.[3]

Once an estimate of total gasoline movement through service stations is made, emission estimates can be made using appropriate emission factors and other variables shown in AP-42. Two important variables affecting organic emissions are the average gasoline vapor pressure in the area and the average temperature during the period of concern. An

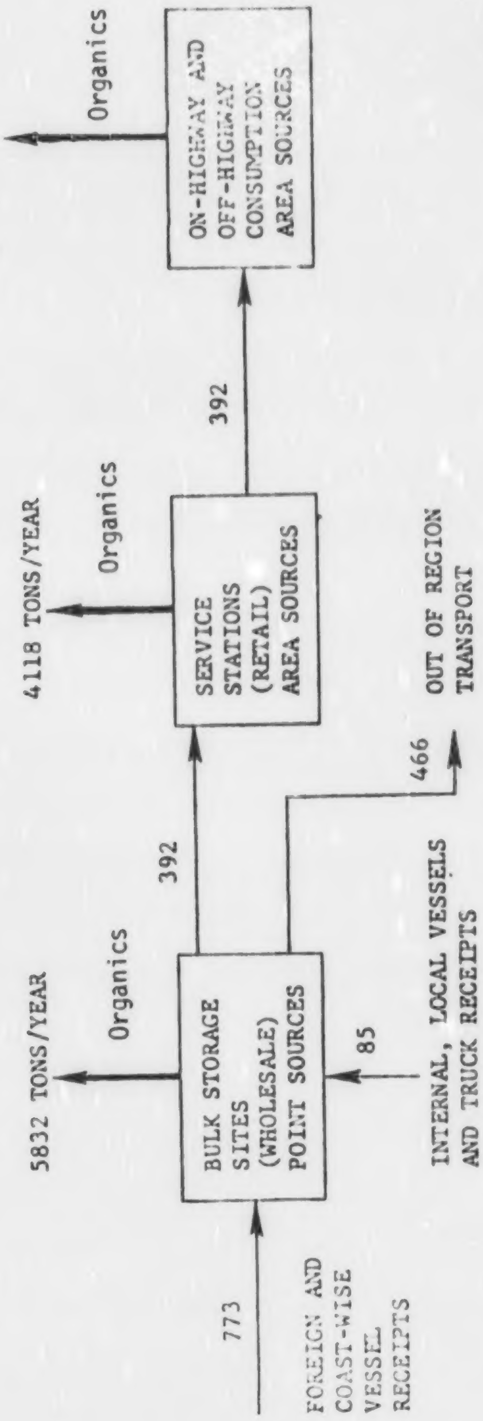
FOREIGN AND COAST-WISE VESSEL RECEIPTS
773
BULK STORAGE SITES (WHOLESALE) POINT SOURCES
5832 TONS/YEAR
Organics
85
INTERNAL, LOCAL VESSELS AND TRUCK RECEIPTS
392
466
OUT OF REGION TRANSPORT
SERVICE STATIONS (RETAIL) AREA SOURCES
4118 TONS/YEAR
Organics
392
ON-HIGHWAY AND OFF-HIGHWAY CONSUMPTION AREA SOURCES
Organics

Figure 5.2-1. Example Gasoline Flow Chart for an Area
(Gasoline flow in millions of gallons)

average gasoline vapor pressure can be estimated by contacting suppliers in the area or default values can be obtained from AP-42. Temperature records, of course, should be readily available for any area of concern from a local weather service.

5.2.2 Dry Cleaning Losses

The dry cleaning industry uses two basic types of organic solvents in the cleaning of clothes: petroleum solvents and chlorinated synthetic solvents (perchloroethylene and triclorotrifluoroethane). Approximately 90 percent of all dry cleaning establishments use perchloroethylene solvent and approximately 63 percent of all clothes are cleaned with this material.[4] Volatile organic emissions occur mainly from the hot air tumbler process of drying the solvent soaked garments.

Dry cleaning establishments may be treated as point sources if the agency has sufficient resources, but are often treated collectively. If treated as point sources, drycleaners can be sent questionnaires to obtain information on the amount of solvent each plant uses. An example questionnaire for dry cleaning is included in Appendix C.

If dry cleaners are treated as area sources, an estimate of total cleaning solvent use will have to be obtained for the area of concern. One possible approach involves contacting or sending questionnaires to the major manufacturers, suppliers, and reprocessers of the solvents in the survey area. The disadvantage of this method is that not all of the solvents supplied to the users is consumed since a certain amount is stored, returned, or discarded. This will result in a bias in the resulting emission estimates.

An alternative is to employ the Census of Business[3] information on dollar receipts from customers. Total dollar receipts can be divided by an average figure for the cost of the solvent (e.g, approximately $15/gallon for perchloroethylene[4]) to get an estimate of total solvent consumption. Needless to say, this technique provides, at best, a rough estimate of area-wide usage. It yields better results when used with a large-scale inventory.

Another approach is to assume that solvent use is proportional to population. Based on data from a recent study[4] in one area, 0.53 pounds of organics are emitted per capita per year. Older data[5] suggest 2 to 2.7 pounds of solvent per capita are emitted per year. Local point source data could be used to estimate a more appropriate per capita factor for use in the survey area.

If questionnaires, plant visits, etc. are utilized to obtain solvent use in larger dry cleaning plants, the amount of solvent used by these point sources can be subtracted from the total solvent use estimated by one of the above techniques to estimate the area source component.

Dry cleaning emissions are generally assumed to equal the amount makeup solvent consumed by a plant. Because the quantity of solvent used will often be reported by volume (e.g., gallons), an average solvent density will be required to determine emissions. If solvent densities are not available either from questionnaires or local suppliers, an average density of 6.7 pounds per gallon can be assumed.[5]

5.2.3 Degreasing and Surface Coating Losses

Small degreasing and surface coating operations, like dry cleaning plants, can be handled individually as point sources if the agency has sufficient resources and desires additional inventory accuracy. If treated as area sources, solvent use information can be obtained from manufacturers, suppliers, and reprocessors. This can be done via questionnaires, telephone contacts, or field surveys.

A significant fraction of emissions from this category is attributable to "trade-paint" sales, i.e., paints distributed through retail stores to the general public. As a rough average, trade-paint sales can be estimated in a survey area[4] by assuming approximately 2.5 gallons are used per capita per year. In addition, an average volatile organic compound content of trade-sale paints is about 17.5 percent, by volume, or about 1.14 pounds per gallon of paint. (This is based on a weighted average taking into account the percent of volatiles in all water- vs. solvent-based paints and a typical split of water- vs. solvent-based paint usage. A density of 6.5 pounds per gallon is also assumed.) Assuming all of the solvent evaporates upon drying, emissions are then determined by multiplying the number of people in the study area by 3.5 (1.14 x 2.5). Needless to say, this will result in a crude estimate that should only be used if locale-specific data are not available.

Note that EPA has developed a computerized technique for apportioning nationwide degreasing and surface coating solvent use data to the state and county level using techniques developed in Reference 6. This information can be obtained by contacting the National Air Data Branch, Research Triangle Park, NC 27711.

Solvent use by point sources should be subtracted from the total estimated solvent use in the area to determine the quantity of solvent used by area sources.

Because some information on surface coating operations may only report the total amount of coating used rather than the amount of solvent in the coating, the agency should obtain average percentages of solvent in various coatings used in the area. In addition, average densities of both the surface coating materials and the solvents themselves should be estimated in order to convert volumes to weights. Typical values of these parameters can be obtained either from the point source questionnaires obtained from larger operations in the area or from local suppliers or manufacturers.

5.2.4 Cutback Asphalt Paving Losses

Cutback asphalt is a type of liquified road surface that is prepared by blending or "cutting back" asphalt cement with various kinds of petroleum distillates. Cutback asphalt is used as a pavement sealant, tack coat, and as a bonding agent between layers of paving material. Organics are emitted to the atmosphere as the cutback asphalt cures and the petroleum distillate used as the diluent evaporates. The diluent content of cutbacks ranges from 20 to 50 percent (by volume), averaging 35 percent. Gasoline or naptha is used as the diluent in "rapid cure" cutback; kerosene is used in "medium cure" cutback; and low volatility fuel oil-type solvents are used in "slow-cure" road-oils.[7]

Inventorying techniques are not well developed for this source category. As an approximation, emissions can be estimated by assuming 80 percent of the diluent evaporates from rapid cure cutbacks, medium cure--70 percent, and slow cure--25 percent.[7] Hence, information on the quantity of each of these types of asphalts that are applied in an area should be obtained from state or local transportation departments or from the Asphalt Paving Institute. The percent diluent in each type of asphalt should be determined from these sources, as well. However, the above averages can be used as default values in the absence of local data.

5.2.5 Pesticides Applications

The application of pesticides has only recently been identified as a potentially significant source in certain areas. Pesticides contain various organic compounds (both "active" and "inert", from a toxicological standpoint) that evaporate as the pesticide is applied and for some time thereafter.

Accurate techniques for assessing the total quantity of pesticide applied in an area have not been developed nor have dependable estimates been made of the fraction of active and inert organics that volatilizes. As a first order approximation, the agency may contact a state food or agricultural department for any pesticide use data available for the survey area. The "active" ingredients should be totaled and then multiplied by an estimated 90 percent volatilization factor while the remaining "inerts" can be assumed to be only 10 percent volatile. This approach is believed to yield a conservative estimate of pesticide emissions as all applications of pesticides may not be accounted for typically.[8]

In some areas, unburned motor oil and/or petroleum distillates such as diesel fuel are used as "weed oils." A portion of this material becomes vaporized upon application. This practice should be investigated if it is common in a locality. Inventorying techniques are not well developed for this source nor are estimates available of the fraction of weed oil that vaporizes.[9]

5.2.6 Other Solvent Uses

Nationwide production data indicate that a great deal more organic solvent is produced than is specifically accounted for in most inventories. For example, Reference 6 estimates that several million tons of special napthas are produced in the U.S. annually, but little information exists on what industries use them and in what products they are found. It is not even known whether or not they are all evaporated. Work is underway to account for the uses of these various solvents. Specifically, the major industrial/commercial/residential sectors will be identified wherein these solvents are used, and methodologies will be developed to estimate organic emissions from their use at various geographical levels.

Currently an estimated 2.6 million tons of solvent is used each year in the United States that is not specifically accounted for in organic inventories.[10] Based on this estimate, crude annual emission estimates can be made by assuming 24 pounds of "other" solvent is used per capita in the survey area.

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5.3 Solid Waste Disposal

Solid waste disposal (by burning) can represent a significant source of organic emissions in many areas. The area source solid waste category includes on-site refuse disposal activities by residential, industrial, and commercial/institutional sources. On-site incineration refers to unconfined burning of waste such as leaves, landscape refuse, or other rubbish. Large open burning dumps and municipal incinerators are usually classed as point sources; however, many smaller incinerators may be so classified, depending on the needs of the agency. For emission inventory purposes, only solid waste that is actually burned is of interest. Unfortunately, very little quantitative information about on-site solid waste disposal is available.

Some locales have conducted comprehensive surveys of solid waste disposal practices. If such a survey is available, it should be obtained and used to estimate solid waste quantities. Many such surveys cover only collected waste, however, and are of limited value for determination of on-site waste disposal quantities.

In the event that data from a solid waste survey are not available, solid waste quantities are usually estimated by per capita generation factors. Nationwide, it is estimated that about 10 pounds of solid waste are generated per capita per day.[1] By judging the proportion of the waste disposed of by various methods, estimates of waste quantities for on-site incineration and open burning can be made. In addition, several surveys of nationwide solid waste disposal practices have provided data useful for estimation of area source solid waste quantities.[2-4]

It should be noted that data based on nationwide or regional averages may yield extremely inaccurate predictions of solid waste quantities for local areas. Due to the tremendous variation in solid waste disposal practices from one community to another, such nationwide averages should be considered rough estimates at best. Furthermore, local regulations governing solid waste disposal should be taken into account. In some areas, open burning and on-site incineration are regulated and may be prohibited. If one or both of these practices is prohibited, the corresponding generation factor(s) should not be applied. Under such circumstances, assume that the solid waste that would normally be allotted to on-site disposal is handled by some other method (e.g., landfilling) not involving burning of any sort.

5.3.1 On-Site Incineration

If no better data are available from surveys or other reliable sources, the factors given in Table 5.3-1 may be used to estimate on-site solid waste incineration by residential, commercial/institutional, and industrial sources. Care should be taken in the application of these factors. If a number of on-site incinerators have been identified as point sources, it may be appropriate to reduce or eliminate the area source estimates. If data are available from registration or permit files for solid waste disposal equipment, these data may provide a more accurate estimation of on-site incineration quantities. Reference 4 presents additional data on incinerators (e.g., size of units, controls, etc.) that may be useful in making more detailed estimates for on-site incineration.

Table 5.3-1 Factors to Estimate On-Site Incineration 2-6

EPA Region	Residential (Tons/1000 population/yr)	Commercial/Institutional (Tons/1000 population/yr)	Industrial (Tons/1000 mfg employees/yr)
I	52	64	125
II	11	65	180
III	4	54	560
IV	4	23	395
V	61	87	420
VI	23	33	345
VII	75	37	325
VIII	87	49	430
IX	90	5	80
X	90	29	170
National avg.	41	50	335

5.3.2 Open Burning

Virtually no data are available to estimate open burning activities. The extent of open burning can best be estimated by contacting the most knowledgeable officials and taking into account the effects of local air pollution regulations restricting or prohibiting open burning. If no local estimates can be made, the factors in Table 5.3-2 may be used:

Table 5.3-2 Factors to Estimate Open Burning [2,3,5-7]

EPA Region	Residential (Tons/1000 population/yr)	Commercial/Institutional (Tons/1000 population/yr)	Industrial (Tons/1000 mfg employees/yr)
Nationwide ave.	122	12	160

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5.4 Small Stationary Source Fossil-Fuel Use

This source category includes small boilers, furnaces, heaters, etc. that are too small to be considered point sources. Generally, both point and area source combustion equipment produce small amounts of organics relative to many other sources; hence, the agency may not consider it worthwhile to perform the detailed procedures given below if its primary concern is updating the VOC inventory and if an existing inventory already includes combustion. The following procedures may be followed if the VOC inventory is detailed or if other pollutants are of concern that are emitted from small stationary source fuel combustion. Because organic emissions from this source are estimated by simply multiplying fuel use by an appropriate emission factor, the techniques below are designed to yield fuel use data for various types of combustion equipment.

Area source stationary source fuel use is usually divided into subcategories. These are:

1. Residential: Included are residential dwellings in structures of fewer than twenty units, so that large apartment houses are excluded.
2. Commercial-Institutional: Included are establishments engaging in retail and wholesale trade, schools, hospitals, government buildings, and apartment complexes with more than twenty units per structure. The commercial/institutional category covers all establishments defined by SIC groups 50-99.[1]
3. Industrial: This category covers all manufacturing establishments not classified as point sources. Included are those establishments defined by SIC groups 19-30.[1]

Collectively, the three categories above account for all the stationary fuel combustion activities that are not usually reported as point sources.

The area source fuel use total is determined by subtracting all fuel used by point sources from the area-wide total of fuel use. Hence, before a specific methodology can be applied to calculate area source fuel use, the total fuel consumed in an area must be determined. Such data are usually obtained from either fuel dealers and distributors, published references, or government regulatory agencies. Some fuel retailers maintain sales records that can be a valuable source of information for the determination of total fuel consumption. The information needed from fuel dealers concerns their annual sales (preferably by county) to each source category. The area source totals of residential and commercial/institutional fuel consumption are then simply the fuel dealers' figures minus any fuel consumed by point sources included in these source categories. It is important that all fuel dealers be contacted. The accuracy of survey results will be significantly reduced if some fuel dealers are overlooked. It may be that not all fuel dealers will be able to furnish adequate information. Generally, natural gas dealers can best furnish the required data. Other dealers either are reluctant to release information, or simply do not have the detailed breakdowns required.

Unfortunately, the above techniques cannot assure that fuel dealer sales accurately represent fuel consumption. Sales of coal to industrial sources or of wood to residential sources, for instance, may represent only a part of the total fuel consumed as much of the fuel consumed in some areas may not come from retail dealers. Other methods should be used for those cases in which fuel dealers cannot provide adequate data on total fuel sales. It should be emphasized, however, that information provided by dealers, although perhaps incomplete, can provide insights into fuel use patterns that would not be discovered by other methods. An example questionnaire for obtaining fuel use data from fuel suppliers is included in Appendix C.

Published references are the most common sources of fuel use data. Reports produced by the U.S. Bureau of Mines contain data on fuel sales and distribution. The advantages to the use of this information are that the data are readily available for all parts of the nation and are updated every year. The drawback to the use of this material is that fuel data are reported by states only, without being broken down into the desired source categories. In addition, county totals must be estimated by apportioning state totals. This geographical apportioning step, which may also be necessary for data obtained from fuel dealers, can become quite complicated and involve a large number of calculations.

Finally, useful data may sometimes be obtained from Federal and state regulatory agencies. The Federal Power Commission compiles data on fuel used by electric utilities[2] and also for natural gas company sales and pipeline distribution.[3] State utility commissions may be able to provide similar data. In addition, state revenue or tax departments may have data that would be helpful for determining fuel usage.

5.4.1 Fuel Oil Consumption

Data collection for fuel oil consumption covers the use of both distillate and residual oil. Distillate oil includes fuel oil grades 1, 2, and 4. In addition, diesel fuel and kerosene can be considered distillate-type oils. On a nationwide scale, residential and commercial/institutional sources are the largest consumers of distillate oil.

Residual oil includes fuel oil grades 5 and 6. In most areas, residual oil is not used by residential sources, but significant amounts may be consumed by industrial and commercial/institutional users.

Literature data must generally be relied upon to determine total fuel oil consumption. Local fuel dealers and government agencies have usually been unable to supply adequate data on fuel oil use. The data published by the Bureau of Mines in Sales of Fuel Oil and Kerosene[4] are the most acceptable. For selected years, data are also available from the Census of Manufacturers,[5] published by the Bureau of the Census. This publication is not produced annually, however, so is of limited use for most area source inventory purposes.

A step-by-step procedure[6] for determining area source fuel consumption is described below using Bureau of Mines, Census of Manufacturers, and other published data.

Step 1: Determine state fuel oil use by source category.

a. Residential: Residential distillate oil use for a state is the sum of the county totals determined according to the method given in Step 3.a. Unless information is available to indicate otherwise, residential use of residual oil can be assumed to be negligible.

b. Commercial/Institutional: State commercial/institutional fuel oil use must be derived from data given in Sales of Fuel Oil and Kerosene.[4]

Commercial distillate oil = F_c x (distillate oil and kerosene used for heating - residential distillate oil) + distillate oil for military use.

Commercial residual oil = F_c x residual oil used for heating + residual oil for military use.

F_c is a commercial employment fraction determined as follows:

$$F_c = \frac{\text{Employment in SIC groups 50-99}}{\text{Employment in SIC groups 19-39 + Employment in SIC groups 50-99}}$$

Employment by SIC groups is given in County Business Patterns.[7]

c. Industrial: For the years for which data are available from the Census of Manufacturers,[5] distillate and residual oil state totals are taken directly from that publication. Otherwise, the following calculations using data from Sales of Fuel Oil and Kerosene[4] are performed:

Industrial distillate oil = F_I x (distillate oil and kerosene used for heating - residential distillate oil) + distillate oil for industrial use + residual oil for oil company use.

Industrial residual = F_I x residual oil used for heating + residual oil for industrial use + residual oil for oil company use.

F_I is an industrial employment fraction.

$F_I = 1 \;\; F_c$ or

$$F_I = \frac{\text{Employment in SIC groups 10-39}}{\text{Employment in SIC groups 19-39 + Employment in SIC groups 50-99}}$$

Step 2: Subtract point source industrial fuel oil use from the industrial state total and subtract the point source commercial fuel oil use from the commercial state total.

Step 3: Determine county fuel oil use.

a. Residential: Residential distillate oil use is calculated as follows:

$$F = \left(\frac{.01288D + 30.41P - 79.54}{.14}\right) S + 250W$$

F = Residential fuel oil use (gallons/year).

D = Annual heating degree-days.

R = Average rooms per housing unit.

S = Number of housing units in structures of fewer than 20 units using oil for space heating.

W = Number of housing units using oil for water heating.

Degree-days are defined as the difference between the mean daily temperature and 65°F. Annual heating degree-days may be obtained from the Local Climatological Data publications of the U.S. Department of Commerce.[8] The degree-days for a weather station in or as close as possible to the area of interest should be selected. The average rooms per housing unit and number of housing units using oil for space heating and water heating may be obtained from the Census of Housing.[9, 10] To update the Census of Housing data to non-census years, the following method may be used:

1. The number of oil burners installed in new homes during the time span between the year of concern and the census year is expressed as a percentage of the number of oil burners in use at the end of the census year (factor 1).

2. The number of conversions to oil burners minus the oil burners lost to other fuels during the time span between the year of concern and the census year is expressed as a percentage of the number of oil burners in use at the end of the census year (factor 2).

3. Housing units using oil in year t = housing units using oil in the census year prior to t + (factor 1 + factor 2) x housing units using oil in the census year prior to t.

Data from Reference 11 or independent estimates may be used to derive the above factors.

b. Commercial/Institutional: Countywide distribution of commercial distillate and residual oil is based on the following steps:

(1). Calculation of estimated total energy use in each county by hospitals, hotels, schools, colleges, and laundries, based on correlative relationships between fuel use and employment. For each category the appropriate equations are as follows:[12]

Hospital energy use (10^6Btu/year) = (12.6) (Beds) + 7.7 (employment) + (1.3) (Degree-days) - 5730.

Hotel energy use (10^6Btu/year) = $[6.25 \times 10^{-10} + 2.96 \times 10^{-12}(\text{Rooms}-600)]$ $(\text{Degree-days})^{3.99}$

School energy use (10^6Btu/year) = (16.5) (employment) + (0.41) (degree-days) - 1820

University energy use (10^6Btu/year) = (22.9) (Employment) + (5.2) (Degree-days) - 29,400

Laundry energy use (10^6Btu/year) = (53.1) (Employment) - 1275

Data required for the above equations may be obtained from local sources or derived from published information described or given in

References 7, 8, and 12. If County Business Patterns[7] employment data are used, it is necessary to add the employment for publicly owned institutions, since these data are not included in the CBP summaries. The addition of employment for public institutions is vital, particularly for the school and universtiy categories. If data on public school and university employment are not available from local sources, Reference 12 describes a method to estimate the data.

Hotel rooms may be determined by dividing the employment for all establishments with SIC 7011 by the appropriate room/employee ratio given in Table 5.4-1 for each state.

Table 5.4-1 Room/Employee Ratios for Hotels by State[6]

State	Ratio	State	Ratio	State	Ratio
AL	.28	KY	.30	ND	.21
AK	.21	LA	.38	OH	.31
AZ	.29	ME	.16	OK	.22
AR	.39	MD	.29	OR	.29
CA	.27	MA	.34	PA	.36
CO	.29	MI	.27	RI	.36
CN	.37	MN	.35	SC	.28
DE	.13	MS	.28	SD	.16
DC	.58	MO	.30	TN	.28
FL	.34	MT	.20	TX	.32
GA	.33	NB	.26	UT	.22
HI	.56	NV	.80	VT	.26
ID	.21	NH	.23	VI	.29
IL	.32	NJ	.27	WA	.26
IN	.30	NM	.23	WV	.29
IO	.28	NY	.32	WI	.31
KA	.23	NC	.22	WY	.20

2. Determination of the fractions of this fuel use attributable to distillate and residual oil based on the fuel use patterns in each state. In order to determine the fuel choice for the subcategories, assume that the ratio of coal, distillate oil, residual oil and gas and electricity use may be obtained from References 13, 14, and 15 using the methods outlined in following chapter subsections. Totals must be converted to common units of Btu/year using the appropriate conversion factors. The distillate and residual fuel oil use then equals the total obtained from step (1) times the percent of total commercial energy use estimated for the appropriate fuel. Thus, if 30 percent of the commercial energy used in a state is estimated to be supplied by distillate oil, the distillate oil used by the categories noted in step (1) equals 0.3 times the total derived in step (1).

3. Calculation of distillate and residual oil consumed by housing units in structures of 20 units or more in each county. Assume that units in structures of more than 50 units consume residual oil and that all other dwelling units included under the commercial category consume distillate oil. The

appropriate data may be obtained from the Census of Housing[10] and the fuel use calculated using the equation given for calculation of residential fuel use. The number of housing units in structures of more than 20 units using oil is obtained by assuming that the proportion of these units using oil is the same as for all housing units.

4. Subtraction of the oil totals from (2) and (3) from the state totals for commercial distillate and residual oil use.

5. Subtraction of the employment totals for the categories mentioned under (1) from the respective county and state employment totals.[7]

6. Allocation of the remaining state fuel oil figures by means of the adjusted county and state employment figures.

$$\text{fuel oil consumed in county } i = \frac{\text{adjusted commercial employment in county } i}{\text{adjusted commercial employment in state } I} \times \text{fuel oil consumed in state } I$$

7. Addition of the oil used by the six subcategories to the county oil figures obtained in Step 6.

c. Industrial: County-wide distribution of industrial distillate and residual oil is performed by means of industrial employment figures which have been corrected to exclude employment accounted for by point sources and adjusted by means of a fuel intensity factor which is industry dependent (two-digit SIC).

$$\text{Industrial fuel oil}_{\text{county}\,i} = \frac{\text{adjusted industrial employment}_i}{\text{adjusted industrial employment}_I} \times \text{industrial fuel oil}_{\text{state}\ I}$$

Industrial employment data are first adjusted by subtracting the employment for point sources in each two digit SIC group from the state and county literature totals.[7] The remaining employment totals are then adjusted using fuel intensity factors. For those years for which distillate and residual oil data by state and two digit SIC are available,[5] the fuel intensity factors are represented by barrels/employment factors, which are developed by state and SIC groups. For the years in which such state data are not published, nationwide fuel intensity factors by two digit SIC are used to adjust the employment figures. Nationwide fuel intensity factors are shown in Table 5.4-2. The adjusted employment totals, which represent weighted averages for industrial area source employment, are then used according to the above equation to distribute the area source fuel totals to counties.

Due to the complexity of the above method, it may be very cumbersome to apply on a large scale. Persons who wish to obtain the computer output for selected counties may do so by contacting the National Air

Table 5.4-2 Nationwide Fuel Intensity Ratios[7,16]

SIC	Industry	Ratio
20	Food	0.27
21	Tobacco	0.12
22	Textile	0.13
23	Apparel	0.03
24	Lumber & Wood	0.27
25	Furniture	0.06
26	Paper	0.69
27	Printing	0.04
28	Chemicals	0.88
29	Petroleum	2.83
30	Rubber & Plastics	0.13
31	Leather	0.05
32	Stone, Clay, Glass	0.86
33	Primary Metals	0.87
34	Fab. Metals	0.13
35	Machinery, exc. electr.	0.08
36	Electr. Equipment	0.06
37	Transportation	0.09
38	Instruments	0.07
39	Miscellaneous	0.06
19	Ordinance	0.06

Data Branch, Research Triangle Park, NC 27711 or their EPA Regional Office.

A simplified version of the above method can be employed; however, at some expense to the accuracy of the results. Variations of the above method may include using different correlative relationships to predict fuel oil use. For instance, to predict distillate oil used for space heating, equations of the following types may be used:[6]

$$\text{Oil consumed} = \frac{\text{\# of oil burners} \times \text{avg size (BTU/hr)} \times 8760\ \text{(hr/yr)} \times \text{load}}{140{,}000\ \text{BTU/gallon}}$$

or,

$$\text{Oil consumed} = \frac{\text{\# of oil burners} \times \text{heat loss (BTU/hr)} \times \text{degree-days} \times \text{use factor}}{140{,}000\ \text{BTU/gallon} \times \text{Design Range } (^{\circ}\text{F})}$$

where the heat loss is dependent on the average square feet of building space. The design range is defined as the difference between inside temperature and the design outside temperature for an area. Use of these relationships requires collection of substantially more source data and determination of local load and use factors. Fuel oil trade association publications,[17] oil dealers, and utility companies may be able to provide some of this information. Modifications of the above equations may provide relationships for predicting residential, commercial/institutional, or industrial space heating fuel oil use which can be summed to obtain grid, county, or state totals. The derived totals should be adjusted to conform with the state totals given in literature references.[4] This step corrects for variations in the parameters used in the above equations.

5.4.2 Coal Consumption

A determination of consumption of both anthracite and bituminous coal may be necessary. Anthracite, or hard coal, is produced almost exclusively in Pennsylvania and is available in significant quantities only in states that are within easy shipping distance from Pennsylvania. Anthracite may be consumed by all source categories, although most is used by residential sources. Production of bituminous, or soft coal, is more widespread than anthracite, so that bituminous coal is available in most areas of the country. Also included as bituminous coal are the lower grades of sub-bituminous coal and lignite. Bituminous coal is often favored for use by electric utilities, manufacturing industries, and coke producers. Bituminous coal is used in some areas for residential and commercial/institutional heating.

The same general techniques used for fuel oil may be adapted to determine coal consumption. Residential coal is calculated for each county based on the following equation:[12]

$$\text{Tons of coal per dwelling unit} = 0.003874\, e^{\left(76.6414 - \frac{999.6}{\text{Degree-Days}}\right)}$$

The number of dwelling units using coal for space heating are obtained from Reference 1 and are updated annually based on additional data from the Bureau of Mines or the Bureau of the Census. Degree-days are obtained from Reference 8. The coal use predicted by the above equation is distributed between anthracite and bituminous coal based on the estimated residential market share of each. Use of coal for non-space heating purposes is ignored. Methods used for calculation of commercial/institutional and industrial coal use are basically the same as those used for fuel oil. State totals are obtained from References 18 and 19.

5.4.3 Natural Gas and LPG Consumption

Few problems should be encountered in determining natural gas use by county. Natural gas companies are usually excellent sources of data. If gas companies are unable to supply adequate data, information from the Federal Power Commission,[3] state utilities commissions, and literature data may be used. Liquified petroleum gas (LPG) may also be considered in area source inventories. The contribution from LPG combustion to total emissions is not significant in most areas. Where LPG use is considerable, however, it may be reported as "equivalent natural gas" by assuming each gallon of LPG is equivalent to 100 cubic feet of natural gas from an emissions standpoint.

Residential natural gas use by county is computed using the following equation:[12]

$$\text{Therms of Natural Gas Consumed} = 47.5 \times A \times B^{0.367} \times \left(\frac{C}{D}\right)^{0.588} \times E^{0.125}$$

Where A = total number of natural gas customers

B = annual heating degree-days

C = number of dwelling units using natural gas for space heating

D = the larger of the number of dwelling units using natural gas for cooking or hot water heating

E = median number of rooms per dwelling unit.

Item A is obtained from American Gas Association reports, B from Local Climatological Data,[8] and C, D, and E, from the Census of Housing.[9] Each parameter is obtained or updated annually.

The resulting natural gas use in therms (one therm = 100,000 BTU) is converted to cubic feet on the basis of natural gas heating value (usually 1000 to 1050 BTU/cubic feet). Residential LPG use is computed by county using a simpler equation based only on number of dwelling units, heating degree days, and a regional use factor for LPG consumed for cooking and water heating.

$$\text{Therms of LPG} = (376 + 0.209\ B) \times H + (I \times J) + (K \times L)$$

where B = degree-days, annual

H = number of occupied dwelling units using LPG for space-heating

I = regional average consumption for water heater, therms

J = number of occupied dwelling units using LPG for water heating

K = regional average consumption for ranges, therms

L = number of occupied dwelling units using LPG for cooking.

Regional average therms consumed by water heaters and for cooking have been estimated by the American Gas Association and are summarized in Reference 12.

Commercial/institutional and industrial natural gas and LPG use may be estimated using the same methodology presented for fuel oil use and obtaining state totals for fuel use from References 14 and 20. However, since natural gas utility companies usually have excellent records of sales by consumer group, data is preferably obtained directly from the gas company. If records are not detailed enough to give county totals, some apportioning may be necessary. If this is the case, the particular institutions and school systems should be contacted directly that comprise the commercial/institutional subcategories identified in Section 5.4.1. If fuel use totals for these categories can be obtained directly, use of the equations and procedures for commercial/institutional subcategories can be avoided. This step is particularly desirable for a detailed source inventory, since the equations in this section and in Section 5.4.1 do not always yield accurate predictions of fuel use for a small area.

5.4.4 Other Fuels

Other fuels which may appear as area source fuels are wood, coke, and process gas. Census of Housing[10] data may be used to estimate residential consumption of wood according to the following equation;[21]

$$\text{Residential wood use (tons/yr)} = 0.0017 \times \text{\# of housing units heating with wood} \times \text{degree-days} \times \frac{\text{average rooms per housing unit}}{5.0 \text{ rooms}}$$

Commercial/institutional and industrial wood use is usually ignored unless surveys of potential sources indicate that wood is consumed by small sources in significant quantities. The most common users of wood as fuel are those wood processing plants that burn wood waste.

Users of coke and process gas can usually be identified only through questionnaire surveys. Neither of these fuels will be used by establishments which are classed as area sources. Process gas use is most common in petroleum refineries, certain chemical processing industries and iron and steel mills. Coke is consumed mainly by iron and steel mills and foundries.

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5.5 Miscellaneous Area Sources

Miscellaneous area sources include forest fires, slash burning, agricultural burning, structrual fires, frost control, and natural organic sources. Many of these sources can produce large quantities of air pollutant emissions in some instances, although they are often intermittent in nature. Some of these sources (e.g., orchard heaters and certain kinds of agricultural burning) are not active during the oxidant season. Miscellaneous area sources are discussed briefly in this section, along with techniques that can be employed for making crude emission estimates.

5.5.1 Forest Fires

Organic emissions from forest fires in certain rural areas can be very large, at least on a short-term basis. Estimates of the quantity and type of growth burned in a area should be available from the U.S. Forest Service, state forestry or agriculture departments, or local fire protection agencies. If local estimates are not available, the U.S. Forest Service annually publishes Wildfire Statistics,[1] which gives the total acreage burned for each state; however, this document does not provide data on acreage burned by counties. For this reason, local officials should be consulted for estimates of acreage burned. If sufficient information cannot be obtained from local officials, the state total from Wildfire Statistics should be apportioned to counties according to forest acreage per county. If this information is not available from the appropriate state or local agency, the total acreage burned can be divided equally between counties with significant forest acreage, as shown on state maps.

The determination of tons of growth burned per acre ("fuel loading") is equally important. Local officials should be contacted for this information. The emissions in the study area are then obtained by multiplying the appropriate emission factor in AP-42 by the fuel loading and by multiplying this product, in turn, by the amount of forest acreage burned.

Average fuel loadings, emission factors, and estimates of organic emissions from forest fires in the various U.S. Forest Service Regions are presented in Section 11.1 in AP-42.

5.5.2 Slash Burning and Agricultural Field Burning

Waste from logging operations is often burned under controlled conditions to reduce the potential fire hazard in forests and to remove brush that can serve as a host for destructive insects. Officials of the U.S. Forest Service or state forestry department should be contacted to provide estimates of the area burned and quantity of slash per acre. If an estimate of the quantity of slash burned per acre cannot be obtained from other sources, a figure of 75 tons per acre can be used.

Also included under this source category are agricultural field-burning operations such as stubble burning and burning of refuse from land clearing. Because no published information is known to be available on this subject, burning activity information must be determined through estimates made by state agriculture departments or extension services.

Estimates of acreage and average fuel loadings should be obtained. The U.S. Soil Conservation Service should be able to provide some of this information. Average fuel loadings and organic emission factors for various wastes are provided in Section 2.4 of AP-42. In some cases agricultural burning may be reported under residential open burning.

5.5.3 Structural Fires

Building fires can also produce short-term emissions of organic compounds. The best procedure for determining information for this source category is to contact local fire departments, fire protection associations, or other agencies for an estimate of the number of structural fires that occur in each county during the year. In the absence of such information assume that an average of four fires per 1,000 population occurs each year.[2]

5.5.4 Frost Control

In some areas, orchard heaters may be used on cold nights during critical portions of the growing season. The county or state agricultural department will often have data on the number and types of orchard heaters that are in use. Data can also be obtained from some of the citrus grove operators in the area. These sources should also be able to furnish the number of nights the units are fired during the year and the approximate length of time each night the units operate. An estimate should also be obtained of the number of units fired at any one time. These data may be used to determine heater-hours of operation. Emission factors for orchard heaters are presented in Chapter 6 of AP-42. In some locales, fuel-filled heaters may be left in the fields for major portions of the year. This practice will increase evaporative emissions and should be accounted for in the inventory.

5.5.5 Natural Organic Emission Sources

Natural sources of organic emissions include biological decay of organic matter; coal, natural gas, and petroleum fields; and vegetation. Vegetation releases appreciable quantities of photochemically reactive volatile organics into the atmosphere.[3] Little is known on the VOC emissions from these other sources, although they are largely believed to be comprised of methane. Detailed studies are being carried out to quantify organic emissions from these and other sources. At this time, no standard methods are available for including these sources in emission inventories. The impact of many natural sources of organics is not believed to be significant relative to peak urban levels of photochemical oxidant. This is due to the low concentrations of emissions from these sources, the lack of any apparent concentrating mechanism, and the general lack of oxides of nitrogen precursors in rural areas where these sources are largely found.[3]

REFERENCES FOR SECTION 5.5

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Chapter 6

EMISSION CALCULATIONS

Once the basic point and area source inventory information has been obtained through the use of the techniques detailed in the preceeding chapters, it must be interpreted, compiled, and entered into the data base. If emissions data are not supplied by a point source, the agency will have to make some sort of emission estimate based on the information obtained from the source together with other information. Area source emission estimates are made by applying an appropriate collective activity level for each separate source category to an emission factor (and in some cases, correction factors) from AP-42 or some other source.

This section primarily deals with the making of emission estimates for the important sources of organic emissions. The use of source test data and material balances will be discussed for estimating emissions from individual point sources. Emission factors, of course, are used to estimate organic emissions from many point sources, and are the primary tool for estimating emissions from area sources.

In cases where no data have been obtained for certain sources, agency may opt to "scale up" the inventory to account for these missing sources rather than expend extra effort in an attempt to get the necessary information. Techniques for accomplishing this are also presented.

6.1 Source Test Data

In many cases, the most accurate method of estimating a source's emissions is to use source test data obtained by the agency or supplied by the plant itself. The use of source test data minimizes the number of assumptions that need be made by the agency regarding the applicability of generalized emission factors, control device efficiencies, equipment variations, fuel characteristics, etc. A single source test or series of tests, taken over a suffciently long time to produce results representative of conditions that would prevail during the time period inventoried, will normally take most of these variables into account. The most complete type of source testing involves continuous monitoring. Although source tests are more frequently performed on large sources, many of the emission factors used to estimate emissions from area sources are based on source tests, as well. Regardless of whether source tests are used to estimate emissions from a single large source, or will be used to develop an emission factor to apply to smaller. area sources, the following procedures are applicable.

Most source test reports summarize emission results for each pollutant by expressing them in terms of a mass loading rate (weight of pollutant emitted per unit time), emission factor (weight of pollutant emitted per unit of process activity), or in terms of a flue gas concentration (weight or number of moles of pollutant per some weight or volume of flue gas). Generally, when a mass loading rate or emission factor is provided, the resulting emission estimate can be easily calculated. For example, if the average organic emission rate for the time period during which the source was tested was 10 lb/hr, and the source operated for 16 hr/day, 350 day/year, daily emissions would be 160 lb and the annual emissions would be 56,000 lb (28 tons). Or, if an emission factor of 1 lb of organics per ton of product were given, and the plant produced

160 tons of product per day for 350 days per year, simple multiplication would yield the same daily and annual emission estimates as above.

If the source test results are expressed in terms of concentrations, the emission calculations are more detailed. As an example, assume that volatile organic emissions are expressed as parts per million, as shown in Table 6-1. In this case, the concentration measurement together with the flow rate measurement are utilized to obtain a mass loading rate. A formula for calculating this is shown as part of the calculations in Table 6-1. Note that in this case, the results are expressed as methane and a molecular weight of 16 lb/lb-mole is used in this formula. If the concentration were expressed in terms of another organic compound, the appropriate molecular weight would be used. Upon determining the mass loading rate (0.3 lb/hr, in this example), this rate can be divided by the production rate at the time of testing to yield an emission factor of 0.1 lb organics per ton of production. After averaging the individual mass loading rates and emission factors determined for all runs of the source test, the resulting average mass loading rate or emission factor could be multiplied by the annual operating time or annual production, respectively, to determine annual emissions. Emissions could be calculated similarly for other time periods.

Two points should be noted when using source test data to calculate emissions. First, because source tests are generally only conducted over several hours or days (at most), caution is urged when using these data to estimate emissions over longer time intervals or for conditions different than those under which the test was performed. Adjustments

Example Summary of Source Test Results

Run Number	1	2	3
Date	8-5-71	8-6-71	8-7-71
Stack flow rate	9840	8510	10290
% Excess air	225	227	366
CO emissions (ppm, by volume)	2.5	6.4	4.6
VOC emissions (ppm, by volume, as CH_4)	11.9	6.8	10.9
Process Conditions			
Production rate (tons/hour)	3.0	3.2	3.1

Example Calculation of VOC Emissions

Conversion formula:

$$\text{lb VOC/hr} = 1.58 \times M \times 10^{-7} \times \text{ppm} \times \text{SCFM}$$

where M = molecular weight of reference VOC

Calculation for Run 1:

$$\text{Mass loading rate} = 1.58 \times 16 \times 10^{-7} \times 11.9 \times 9840$$
$$= 0.3 \text{ lb/hr}$$

$$\text{Emission factor} = 0.3 \text{ lb/hr} \times 1\text{hr}/3 \text{ tons production}$$
$$= 0.1 \text{ lb organic/ton production}$$

Table 6-1 Example Source Test Data and Emission Calculations

may be made to account for differing conditions. Second, a source test supplied by a plant may not describe a given facility's annual operating history. (This type of data should be obtained, of course, if the agency is conducting the source test.) In cases where it is not included in the test report, an operating rate, etc. will have to be obtained in order to make reliable inventory estimates. This is best done by contacting the plant and obtaining operating information for the period the test was conducted. Such information could be obtained from questionnaire data but this would not be as accurate.

If source test data is to be utilized to develop an emission factor to be applied to other sources in an inventory, as many tests as possible should be considered. Generally, the more sources within a particular source category that are sampled, and the more runs made during each test, the more representative the resulting emission factor will be, thereby minimizing inventory error. The use of emission factors is discussed in Section 6.3.

6.2 Material Balance

If source test results are not available, the agency can, in some cases, use material balance considerations to estimate emissions from a source. In fact, for some sources a material balance is the only practical method to accurately estimate organic emissions. Source testing of low level, intermittent, or fugitive organic streams can be very difficult and costly in many instances. Most emission factors for evaporative sources, in fact, are determined by the use of material balances.

A material balance involves the examination of a process to determine if the emissions therefrom can be estimated solely by the measurement of specific operating parameters and material compositions. Although the material balance is a valuable tool in estimating emissions from many sources, its use requires that the exact fate of the material in question be known at each point throughout the process. If such knowledge is not available, and therefore assumed, serious errors may result.

In the organic emission inventory, a material balance is generally used to estimate emissions from solvent evaporation sources. This technique is equally applicable to both point and area sources. The simplist form of material balance is to assume that all solvent material consumed by a source will be evaporated during the process operation. For instance, the assumption is reasonable that during many surface coating operations, most or all of the solvent in the coating evaporates during the drying process and is emitted to the atmosphere. In this case, emissions are simply equal to the amount of solvent applied in the surface coating as a function of time. As another example, consider a dry cleaning plant that uses Stoddard solvent as the cleaning agent. To estimate emissions, the agency need only solicit from each plant the amount of solvent purchased during the time interval of concern. Emissions are then equal to the quantity of solvent purchased (the assumptions being that all of the solvent used is evaporated and all of the solvent purchased is used during the interval).

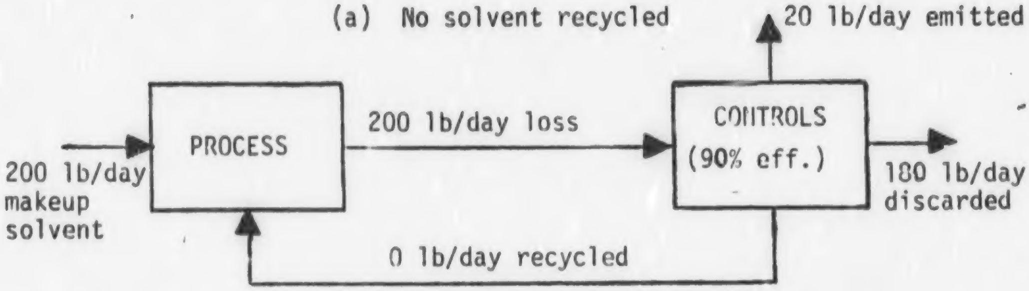
In the above example, the material balance is simplified because of the assumption that all of the solvent evaporates and is emitted to the atmosphere. Situations exist where such an assumption is not always reasonable. For example, if a destructive control device such as an afterburner, incinerator, or catalytic oxidation unit is employed on the process exhaust, any organic emissions will either be destroyed or so altered that one could not reasonably assume, without testing the exhaust downstream of the device, what the characteristics and quantities of any remaining organic material will be. In these cases, however, the amount of organic material reaching the controls could be estimated by material balance, and a control device efficiency (if known) could be applied to estimate emissions to the atmosphere. As another example, some fraction of the diluent used to liquify cutback asphalt is not believed to evaporate after application, but rather, is retained in the pavement. Hence, if one assumes that all of the diluent evaporates, some overestimation of volatile organic emissions would result.

In addition, material balances cannot be employed in some processes because the amount of material lost is either too small to be accurately determined or because sufficient knowledge of the organic content of all incoming or outgoing process streams is not available. As an example, material balances on petroleum product storage tanks are not generally feasible because the breathing and working losses are too small relative to the total average capacity to be readily determined from changes in the amount of material stored in each tank. In these cases, emission factors such as those available in AP-42 will have to be applied that have been developed by special procedures.

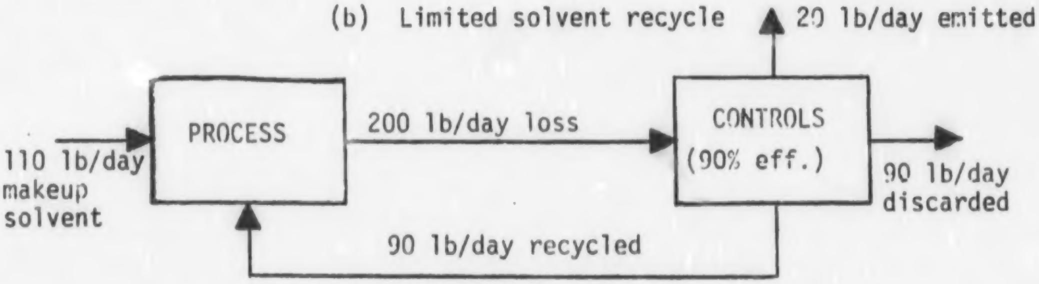
If a nondestructive control device (e.g., a condenser or adsorber) is employed on the process stream, a material balance can be applicable; however, additional information is required. Three situations can occur when a nondestructive control device is used as shown in Figure 6-1. In one case (as shown in Figure 6-1 [a]), all of the collected solvent is discarded (e.g., the solvent is tied up in a sludge that is subsequently discharged into a sanitary sewer or landfilled). In another [shown in Figure 6-1 (b)], some fraction of the solvent collected is discarded, with the remainder being recycled for reuse in the process. Figure 6-1 (c) shows a process where all of the solvent collected is recycled. (In each of these three figures, the basic processes and control devices are identical). If the amount of makeup solvent is known (records are probably kept on this), and if the amount of solvent discarded is available (this will often not be known), emissions can be inferred by difference, i.e., emissions will be equal to the amount of makeup solvent needed minus the amount of solvent that is discarded. As an example, if a degreasing operation consumes, on the average, 200 lb/day of methylene chloride as makeup solvent, and 180 lb/day is collected in a condenser and subsequently discarded, atmospheric emissions will be 20 lb/day. If on the other hand, all of the 180 lb/day collected is recycled, emissions are still 20 lb/day; however, the amount of makeup solvent needed is reduced considerably.

The assumption in the above calculations is that none of the discarded solvent is lost to the atmosphere. In fact, some or all of this solvent may evaporate during subsequent handling (or other) operations at a later time or at another location. For example, if the discarded muck from a dry cleaning plant is landfilled, some fraction of the cleaning agent may evaporate over time and should be accounted for in the inventory. This example points out the importance of knowing the exact fate of the

(a) No solvent recycled


20 lb/day emitted
PROCESS
200 lb/day loss
CONTROLS
(90% eff.)
200 lb/day makeup solvent
180 lb/day discarded
0 lb/day recycled

(b) Limited solvent recycle


20 lb/day emitted
PROCESS
200 lb/day loss
CONTROLS
(90% eff.)
110 lb/day makeup solvent
90 lb/day discarded
90 lb/day recycled

(c) Complete solvent recycle

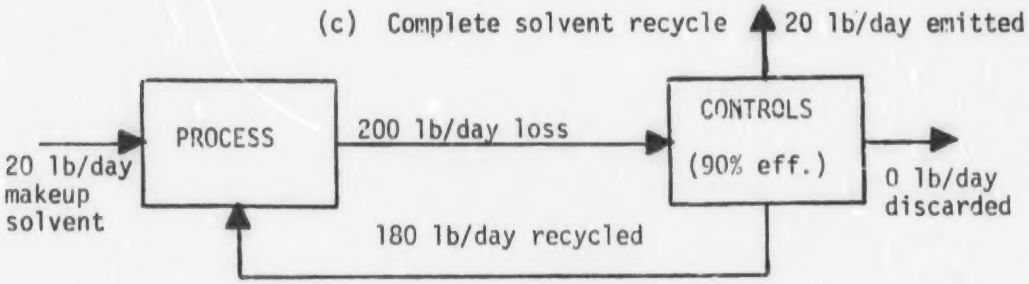

20 lb/day emitted
PROCESS
200 lb/day loss
CONTROLS
(90% eff.)
20 lb/day makeup solvent
0 lb/day discarded
180 lb/day recycled

Figure 6-1 Example Material Balances On Solvent Evaporation Processes Using Nondestructive Control Devices

solvent not only at each point in the process, but during its subsequent history, as well. In extreme cases, the entire quantity of makeup solvent may eventually be lost to the atmosphere regardless of the fact that only some fraction is lost during the process operation itself.

6.3 Emission Factors

One of the most useful tools available for estimating typical emissions from both point and area sources is the emission factor. An emission factor is an estimate of the quantity of pollutant released to the atmosphere as a result of some activity (such as combustion or industrial production) divided by the level of that activity. In most cases in AP-42, emission factors are expressed simply as a single number, with the underlying assumption being that a linear relationship exists between emissions and the specified activity level over the probable range of application. Empirical formulas have been developed for several source categories where sufficient data are available. These formulas allow the agency to base its emission estimates on a number of variables instead of just one. The most important VOC emitters for which empirical formulas are available are highway vehicles and petroleum product storage and handling operations. An example of one such formula is shown later in this section for estimating emissions from a floating roof storage tank. As a rule, the most reliable emission factors are those based on numerous, representative source tests or on an accurate material balance.

The use of an emission factor to estimate organic emissions from a source necessitates that the agency have complete source and control device information. In many cases (e.g., most combustion sources), the emission calculation merely involves the multiplication of the appropriate emission factor times the source activity (e.g., fuel combustion) for the time interval in question. If a control device is installed, the agency also has to have either an emission factor representing emissions after that device, or adjust the uncontrolled emission estimate to account for the effect of the device. (Note: Emission factors in AP-42 generally represent uncontrolled emissions or emissions before a control device.)

When empirical formulas are available, more detailed computations may be needed to estimate emissions. As mentioned above, highway vehicles and petroleum product handling and storage operations present situations where a number of variables must be considered in the emission calculations. Example calculations for each of these important organic emission source categories are presented in AP-42. A simplified example of the calculations of emissions from a bulk storage tank is shown below based upon the data in Table 6-2. As a first approximation of emissions from the tank, the emission factors in Table 4.3-4 of Section 4.3 (4/77 revision) of AP-42 can be utilized. Because the tank is riveted, "old tank" conditions should be assumed. Dividing the tank capacity (in gallons) by 42 yields 67,000 barrels. From Table 4.3-4 in AP-42, a factor of 0.028 pounds of loss per 10^3 gallon capacity is determined by assuming the following conditions: jet naptha (JP-4), a 67,000 barrel tank capacity, and "old tank" conditions for the floating roof tank. Multiplying this factor by the tank capacity (2,814,000 gal) yields emissions of 79 lb/day. This loss rate would then be multiplied by the number of days

Item No.	Data \ Tank Identification No.	020A
	STORED PRODUCT INFORMATION	
1.	Product stored; e.g. crude oil, gasoline, jet fuel, etc.	Jet Fuel
2.	True vapor pressure of liquid at storage temperature (psia/^{o}F)	1.9 psia/80^{o}F
3.	Reid Vapor Pressure of the Stored product (psia)	2.7
4.	Density of product stored at storage temperature (lbs/gal)	6.0
5.	Throughput for the year 1975 (gals/yr)	630,000,000
	TANK INFORMATION	
6.	Tank capacity (gals)	2,814,000
7.	Type of tank: e.g., Fixed Roof, Floating Roof, Variable Vapor Space, Pressure, Horizontal, Spherical, etc.	Floating Roof
8.	If tank is floating roof:	
	a) Type of roof: Double Deck/Pontoon/ Other (describe)	Pontoon
	b) Type of seal: Single/Double/Other (describe)	Double
	c) Type of construction: Riveted/Welded/ Other (describe)	Riveted
9.	Is tank underground or aboveground	Aboveground
10.	Tank dimensions (ft.)	
	a) Diameter (ft-inches)	100-00
	b) Height (ft-inches)	45-6
11.	Tank shape. Cylindrical/Spherical/ Other (describe)	Cylindrical
12.	Tank material of construction: Steel/ Fiberglass/Other (describe)	Steel
13.	Tank paint color: White/Aluminum/Light Grey/Medium Grey/Other (describe)	Aluminum
14.	Tank condition. Good/Fair/Poor	Fair
15.	Seal condition. Good/Fair/Poor	Poor
16.	Average vapor space height (ft)	26
17.	Average wind velocity of the area (mi/hr)	11.5
18.	Date tank installed	1960
19.	Any modifications after tank installation (describe)	none
20.	Average outage, in feet, height of vapor space including allowance for tank roof	22
21.	Is tank equipped with vapor recovery system? Type (describe)	No

Table 6-2 Example Bulk Storage Tank Information

per year the tank was storing jet fuel to obtain annual emissions.

If sufficient resources and the appropriate information are available, the agency can make a more accurate estimate of emissions by using the following empirical formula taken from Section 4.3.2.2 of AP-42.

$$L_S = 9.21 \times 10^{-3} M \left[\frac{P}{14.7 - P}\right]^{0.7} D^{1.5} V_w^{0.7} K_t K_s K_p K_c$$

where: L_S = Floating roof standing storage loss (lb/day)

M = Molecular weight of vapor in storage tank (lb/lb mole)

P = True vapor pressure at bulk liquid conditions (psia)

D = Tank diameter (ft); see note (1)

V_w = Average wind velocity (mi/hr); see note (2)

K_t = Tank type factor (dimensionless)

K_s = Seal factor (dimensionless)

K_p = Paint factor (dimensionless)

K_c = Crude oil factor (dimensionless); see note (3)

Note: (1) For $D \geq 150$, use $D\sqrt{150}$ instead of $D^{1.5}$

(2) API correlation was derived for minimum wind velocity of 4 mph. If $V_w \leq 4$ mph, use $V_w = 4$mph.

(3) $K_c = (0.84)$ for crude oil, $K_c = (1.0)$ for all other liquids.

If such a calculation is to be made, each of the above parameters must be provided to the agency or accurately estimated. (These parameters are explained in detail in Section 4.3 of AP-42.) For the example data shown in Table 6-2, all of the above parameters are supplied except for M and the K factors. From Table 4.3-1 of AP-42, M can be approximated as 80 lb/lb-mole for jet fuel. From Table 4.3-3, K_t is 0.11 for a riveted tank with a pontoon roof and doubleseal. K_s is assumed to be 1.00 since it is a newer tank, K_p is 1.0 since the tank is painted aluminum, and K_c is 1.0 since crude oil is not being stored.

Therefore:

$$L_s = (9.21 \times 10^{-3})\ (80) \left[\frac{1.9}{14.5 - 1.9}\right]^{0.7} (100)^{1.5}\ (11.5)^{0.7}\ (0.11)$$

$$= 119 \frac{\text{lb}}{\text{day}} \quad \text{evaporative loss}$$

The difference in emissions estimated from the two techniques in the above example shows the potential importance of employing the empirical formula when the values for the appropriate parameters are reasonably well known. This is particularly the case when the inventory conditions differ significantly from those assumed in Table 4.3-4 of AP-42. In the above example, the temperature is high enough to result in much more emissions than are estimated by using the factors in Table 4.3-4.

Because temperature is such an important factor in determining emissions from petroleum product handling and storage operations, it should be taken into account whenever the agency needs reliable estimates for this important organic emission source category. Temperature is an especially important variable to take into account when estimating organic emissions from all petroleum product handling and storage operations during the hotter months of the oxidant season. (Adjustment of annual emissions to better represent the oxidant season is discussed in Chapter 7.)

The discussion thus far on emission factors has dealt with the "activity level emission factor," i.e., a factor that relates emissions with some level of production, capacity, etc. This type of emission factor is generally the most accurate as it physically relates the most appropriate process parameters with emissions. Another type of factor that can be of some use is the emission-per-employee factor. As briefly discussed in Chapter 4, emission-per-employee factors represent a technique for obtaining crude estimates of emission potential from a source or source category for which little equipment, production, or other process information is available. Emission-per-employee factors also represent one tool that can be used to "scale up" inventories to estimate emissions from point sources for which no data is individually obtained. (Scaling up the inventory is discussed in the next section.) Generally, because of the error involved in using emission-per-employee factors, other techniques are considered preferable in most instances for estimating emissions.

6.4 Scaling Up the Inventory

The preceeding sections describe general techniques for calculating emission estimates for individual sources on which data was supplied to the agency through questionnaires, plant visits, etc. Although information should be obtained directly from as many sources as possible to enhance inventory accuracy, situations may arise where no data can be gathered from some segment of each source category. In these cases, the inventory can be "scaled up" to provide for a rough accounting of the missing emissions. Scaling up can be considered a technique for dealing with point sources insofar as it is employed to account for those sources that may have been treated individually in the inventory had a questionnaire response been received. However, to the extent that the resulting emissions estimates are generally reported collectively, scaling up can be considered an area source approach.

The basic concept involved in scaling up an inventory is to use the data that have been received through questionnaires, plant visits, etc., from similar type sources to extrapolate emission data for missing sources. The following formula shows the basic computation involved for a particular source category.

$$\text{Nonreported emissions} = \frac{\text{Reported emissions}}{\text{Coverage Fraction}} - \text{Reported Emissions}$$

Coverage fraction is a measure of the extent to which some indicator (e.g., employment, production, sales, etc.) is represented or "covered" by the questionnaire responses. Since "reported emissions" are known, and since the "non-reported emissions" are sought, the problem becomes one of determining the most appropriate indicator that can be used to estimate the fraction of coverage that was obtained in the agency's inventory effort.

The most commonly used indicator for scaling up the inventory is the number of employees within each pertinent SIC. Because the number of employees by SIC is commonly available at the county level, (see Section 4.1.1) and since the agency can readily determine the fraction of employees covered in its inventory, calculating nonreported emissions thus can be accomplished directly.

Other indicators could be used to determine the fraction of coverage instead of the number of employees. For example, the number of facilities

19 FUEL SALES

Type of Fuel	State	County	QUANTITY				
			Residential	Commercial/ Institutional	Industrial	Total	Units

Figure C-3-4 (cont'd.)

II. 19 FUEL SALES

IMPORTANT: It should be noted that sales represented in this survey do not include sales to other fuel dealers (i.e., only to those sources listed in the table).

Where available provide the sales per category and indicate appropriate units in the last column.

	Type of Fuel*	State	County	Annual Quantity				
				Residential	Commercial/ Institutional	Industrial	Total	Units
EXAMPLE:	Bituminous Coal	X	Y	1,503	2,675	9.632	13,810	Tons/yr.
EXAMPLE:	Natural Gas			3,715	7,301	17,832	28,848	1000cf/yr.
EXAMPLE:	#2 F. C.			133	1,504	19,304	20,941	Gal/yr.

DEFINITIONS: Residential: All residential dwellings from single family residences to apartment complexes

Commercial/Institutional: Retail and wholesale stores, schools, hospitals, government and public buildings

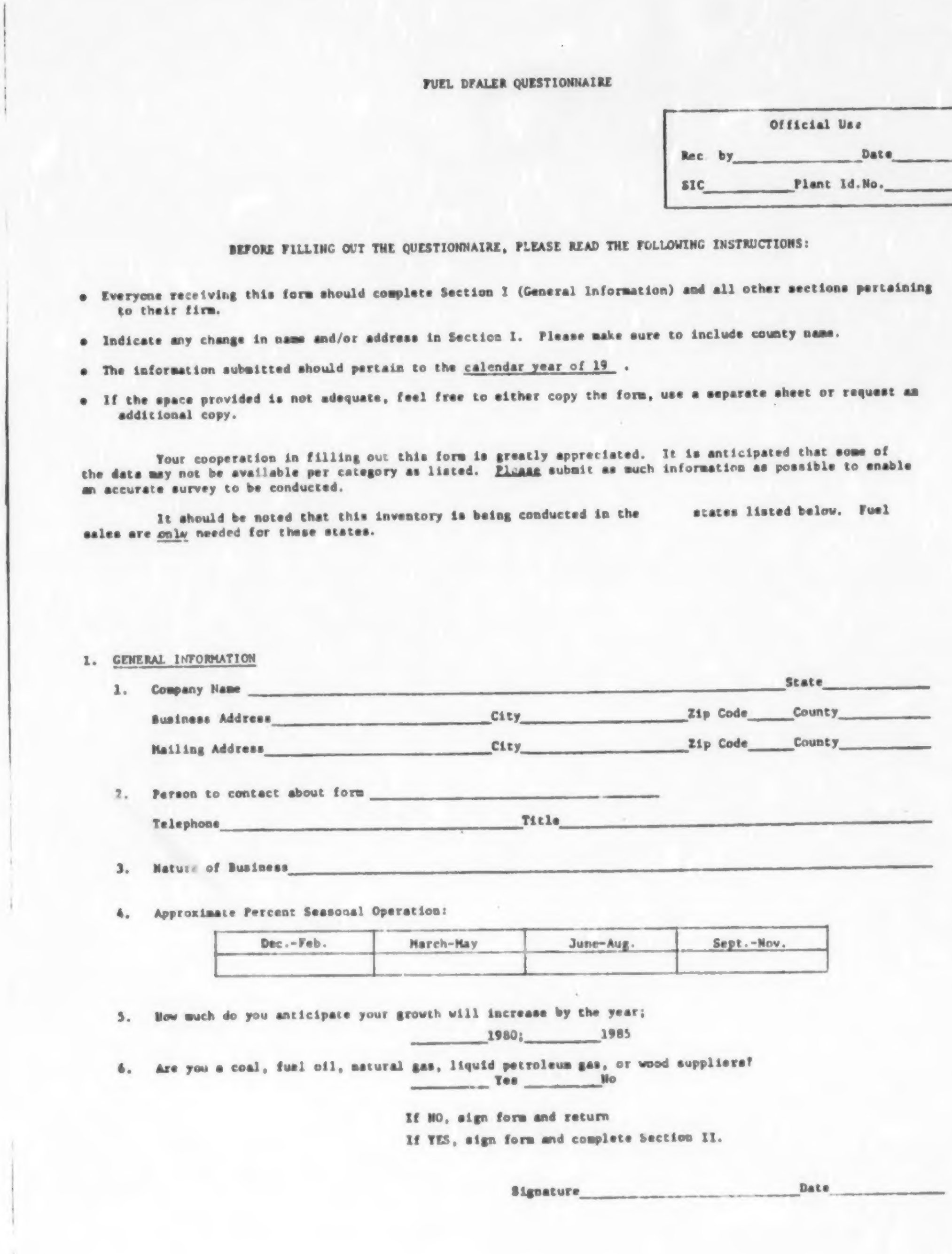
Industrial: All manufacturing industries regardless of size including utilities.

For coal and fuel oil provide an average value of the percent sulfur by weight:

Distillate Oil ____%S Bituminous Coal ____%S
Resident Oil ____%S Anthracite Coal ____%S

*For fuel oils specify number, if available, and for coal specify type (i.e., anthracite or bituminous).

Figure C-3-4 (cont'd.)



FUEL DEALER QUESTIONNAIRE

Official Use

Rec by______________ Date________

SIC__________ Plant Id.No.________

BEFORE FILLING OUT THE QUESTIONNAIRE, PLEASE READ THE FOLLOWING INSTRUCTIONS:

- Everyone receiving this form should complete Section I (General Information) and all other sections pertaining to their firm.
- Indicate any change in name and/or address in Section I. Please make sure to include county name.
- The information submitted should pertain to the calendar year of 19 .
- If the space provided is not adequate, feel free to either copy the form, use a separate sheet or request an additional copy.

Your cooperation in filling out this form is greatly appreciated. It is anticipated that some of the data may not be available per category as listed. Please submit as much information as possible to enable an accurate survey to be conducted.

It should be noted that this inventory is being conducted in the states listed below. Fuel sales are only needed for these states.

I. GENERAL INFORMATION

1. Company Name ______________________________ State__________

   Business Address__________________ City______________ Zip Code_____ County__________

   Mailing Address__________________ City______________ Zip Code_____ County__________

2. Person to contact about form ______________________

   Telephone__________________ Title______________________

3. Nature of Business ______________________________________

4. Approximate Percent Seasonal Operation:

Dec.-Feb.	March-May	June-Aug.	Sept.-Nov.

5. How much do you anticipate your growth will increase by the year;

   ________1980;________1985

6. Are you a coal, fuel oil, natural gas, liquid petroleum gas, or wood suppliers?

   ________ Yes ________ No

If NO, sign form and return

If YES, sign form and complete Section II.

Signature______________________ Date____________

Figure C-3-4 Example Area Source Questionnaire for Fossil Fuel Use

EMISSION INVENTORY
DATA YEAR-19
RAILROAD LOCOMOTIVES

Company Name: ______________________________

Person to Contact Regarding this Information:

____

Phone Number: ______________

Engine Category	Fuel Consumed Within the Boundaries of County in 19 GALLONS	
	Main Line	Switch Yard
2-Stroke Supercharged Switch	________	________
4-Stroke Switch	________	________
2-Stroke Supercharged Road	________	________
2-Stroke Turbocharged Road	________	________
4-Stroke Road	________	________

Seasonal Variation in Fuel Usage

Jan,Feb,Mar	Apr,May,Jun	Jul,Aug,Sep	Oct,Nov,Dec
________%	________%	________%	________%

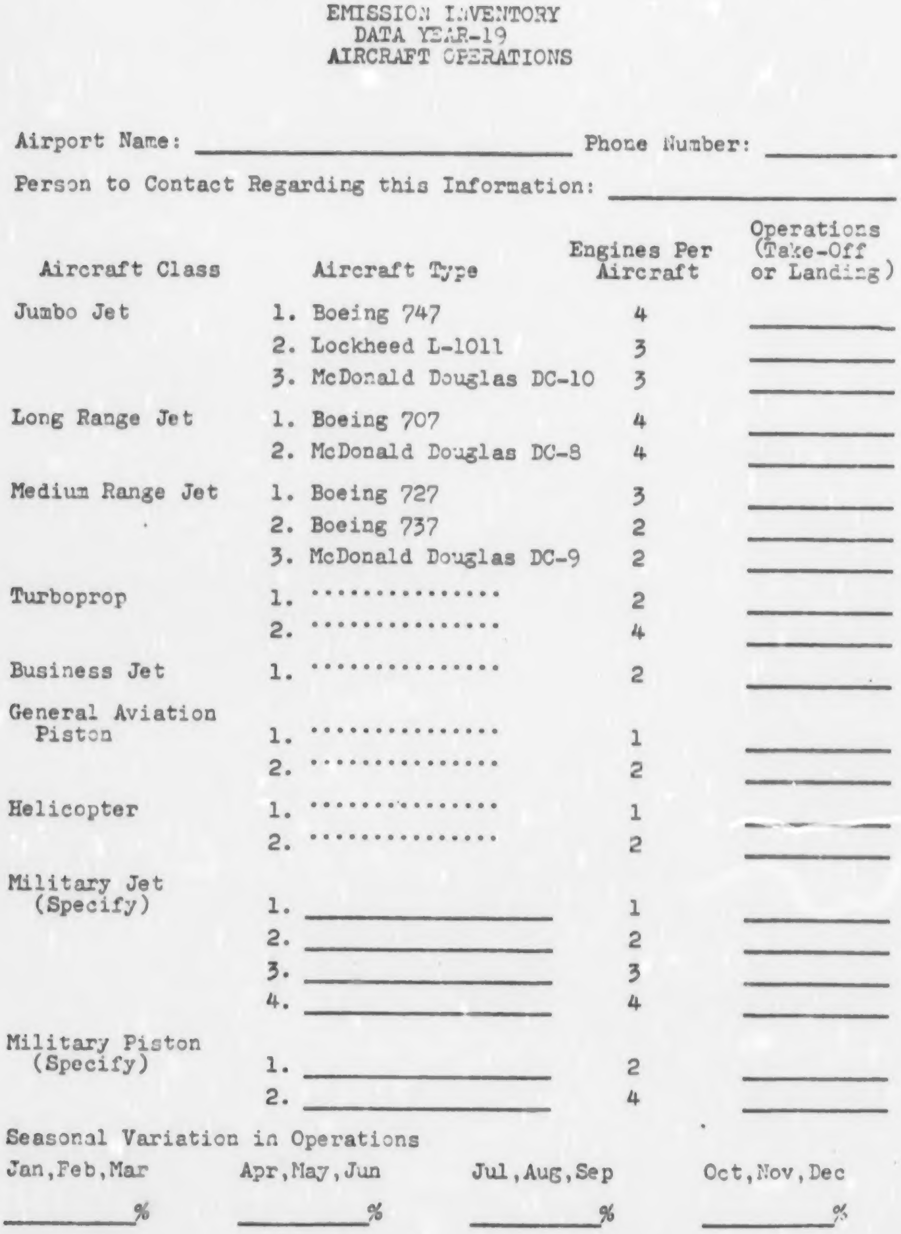
Figure C-3-3 Example Area Source Questionnaire for Railroad Locomotives

TYPICAL TIME IN MODE FOR LANDING TAKEOFF CYCLE AT A METROPOLITAN AIRPORT

Aircraft	Time in mode, minutes				
	Taxi-idle	Takeoff	Climbout TO 3500 FT	Approach FROM 3500 FT	Taxi-idle
Jumbo jet	19.00	0.70	2.20	4.00	7.00
Long range jet	19.00	0.70	2.20	4.00	7.00
Medium range jet	19.00	0.70	2.20	4.00	7.00
Air carrier turboprop	19.00	0.50	2.50	4.50	7.00
Business jet	6.50	0.40	0.50	1.60	6.50
General aviation turboprop	19.00	0.50	2.50	4.50	7.00
General aviation piston	12.00	0.30	4.98	6.00	4.00
Piston transport	6.50	0.60	5.00	4.60	6.50
Helicopter	3.50	0	6.50	6.50	3.50
Military transport	19.00	0.50	2.50	4.50	7.00
Military jet	6.50	0.40	0.50	1.60	6.50
Military piston	6.50	0.60	5.00	4.60	6.50

The emissions from the aircraft are calculated on the basis of the typical time in mode table above. For those aircraft you are familiar with, are the mode times given in the table similar to those experienced at your airport. If there is a significant difference we would like to contact you at a later date to correct the mode times for your specific operation.

Figure C-3-2 (cont'd.)



EMISSION INVENTORY
DATA YEAR-19
AIRCRAFT OPERATIONS

Airport Name: ______________________ Phone Number: __________

Person to Contact Regarding this Information: ____________________

Aircraft Class	Aircraft Type	Engines Per Aircraft	Operations (Take-Off or Landing)
Jumbo Jet	1. Boeing 747	4	
	2. Lockheed L-1011	3	
	3. McDonald Douglas DC-10	3	
Long Range Jet	1. Boeing 707	4	
	2. McDonald Douglas DC-8	4	
Medium Range Jet	1. Boeing 727	3	
	2. Boeing 737	2	
	3. McDonald Douglas DC-9	2	
Turboprop	1.	2	
	2.	4	
Business Jet	1.	2	
General Aviation Piston	1.	1	
	2.	2	
Helicopter	1.	1	
	2.	2	
Military Jet (Specify)	1.	1	
	2.	2	
	3.	3	
	4.	4	
Military Piston (Specify)	1.	2	
	2.	4	

Seasonal Variation in Operations

Jan,Feb,Mar	Apr,May,Jun	Jul,Aug,Sep	Oct,Nov,Dec
________%	________%	________%	________%

Figure C-3-2 Example Area Source Questionnaire for Aircraft Operations

GASOLINE SERVICE STATION QUESTIONNAIRE

Name of station ______________________________

Address ______________________________

Nearest cross street ______________________________

Owner ______________________________

Operator/operator ______________________________

Hours of operation ______________________________

	REGULAR	PREMIUM	UNLEADED	DIESEL	KEROSENE	OTHER
NUMBER OF PUMPS						
NUMBER OF TANKS						
TANK SIZE (GALLONS)						
SUBMERGED FILL TUBE						
PREVIOUS MONTH THRUPUT						
ANNUAL THRUPUT						
TIME OF PEAK PERIODS						

(Name) ______________________________

(Title) ______________________________

(Date) ______________________________

Figure C-3-1 Example Area Source Questionnaire for Gasoline Service Stations

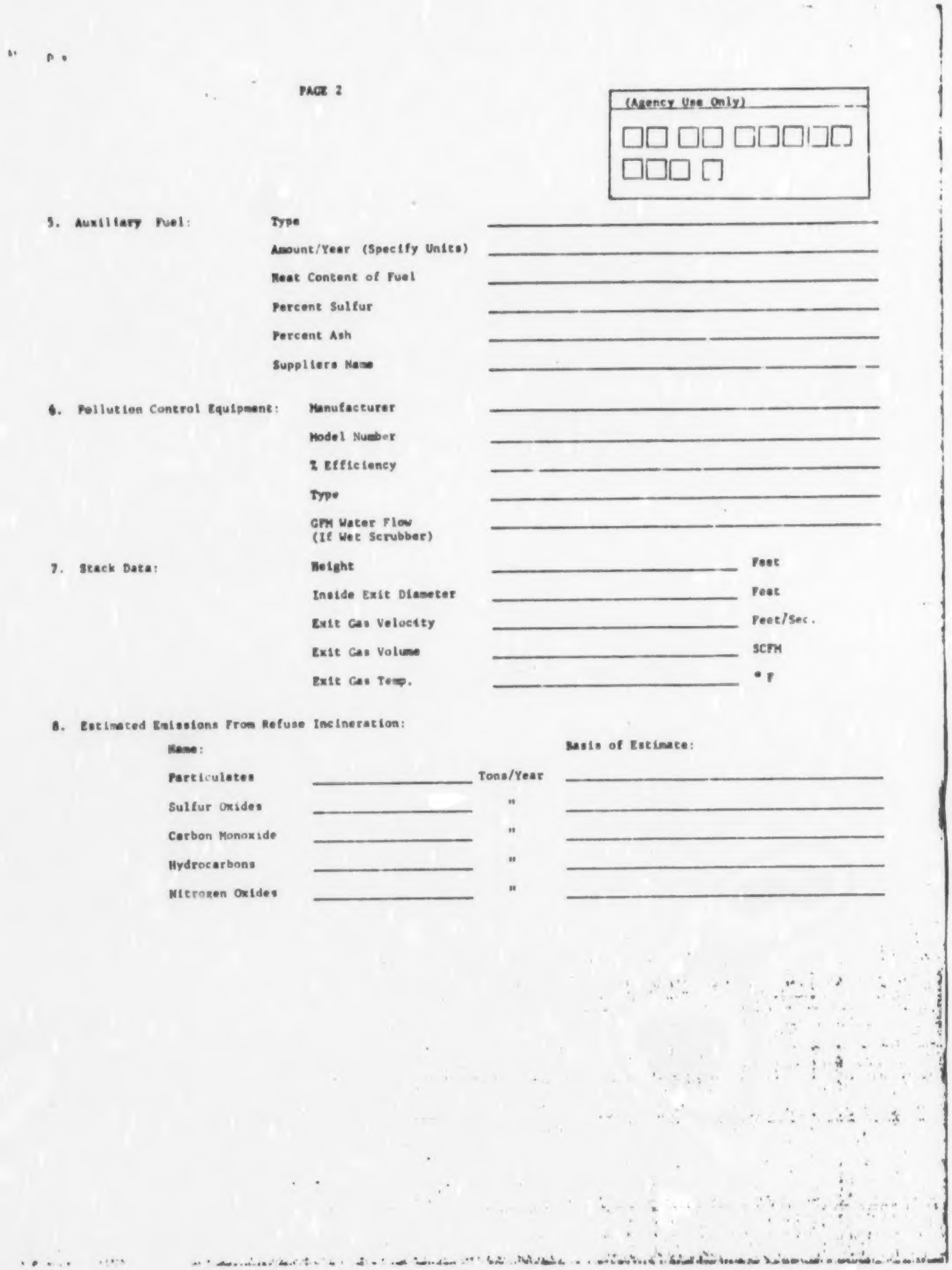
APPENDIX C

SECTION C-3

EXAMPLE AREA SOURCE QUESTIONNAIRES

All questionnaires shown in this document are examples of questionnaires used by others in the past and address a specific set of needs and objectives. These questionnaires have not been examined for total compatibility with all recommendations given in various portions of this document. They should NOT be considered to be EPA recommended questionnaires.

Because questionnaires are such a key item in the conduct of an inventory, they should be developed very carefully in order to reflect the agency's specific needs in its oxidant and other programs. These questionnaires are merely intended to give examples of various types of information that may be obtained in the inventory compilation effort.



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(Agency Use Only)

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5. Auxiliary Fuel:

Type ____________________

Amount/Year (Specify Units) ____________________

Heat Content of Fuel ____________________

Percent Sulfur ____________________

Percent Ash ____________________

Suppliers Name ____________________

6. Pollution Control Equipment:

Manufacturer ____________________

Model Number ____________________

% Efficiency ____________________

Type ____________________

GPM Water Flow (If Wet Scrubber) ____________________

7. Stack Data:

Height ________________ Feet

Inside Exit Diameter ________________ Feet

Exit Gas Velocity ________________ Feet/Sec.

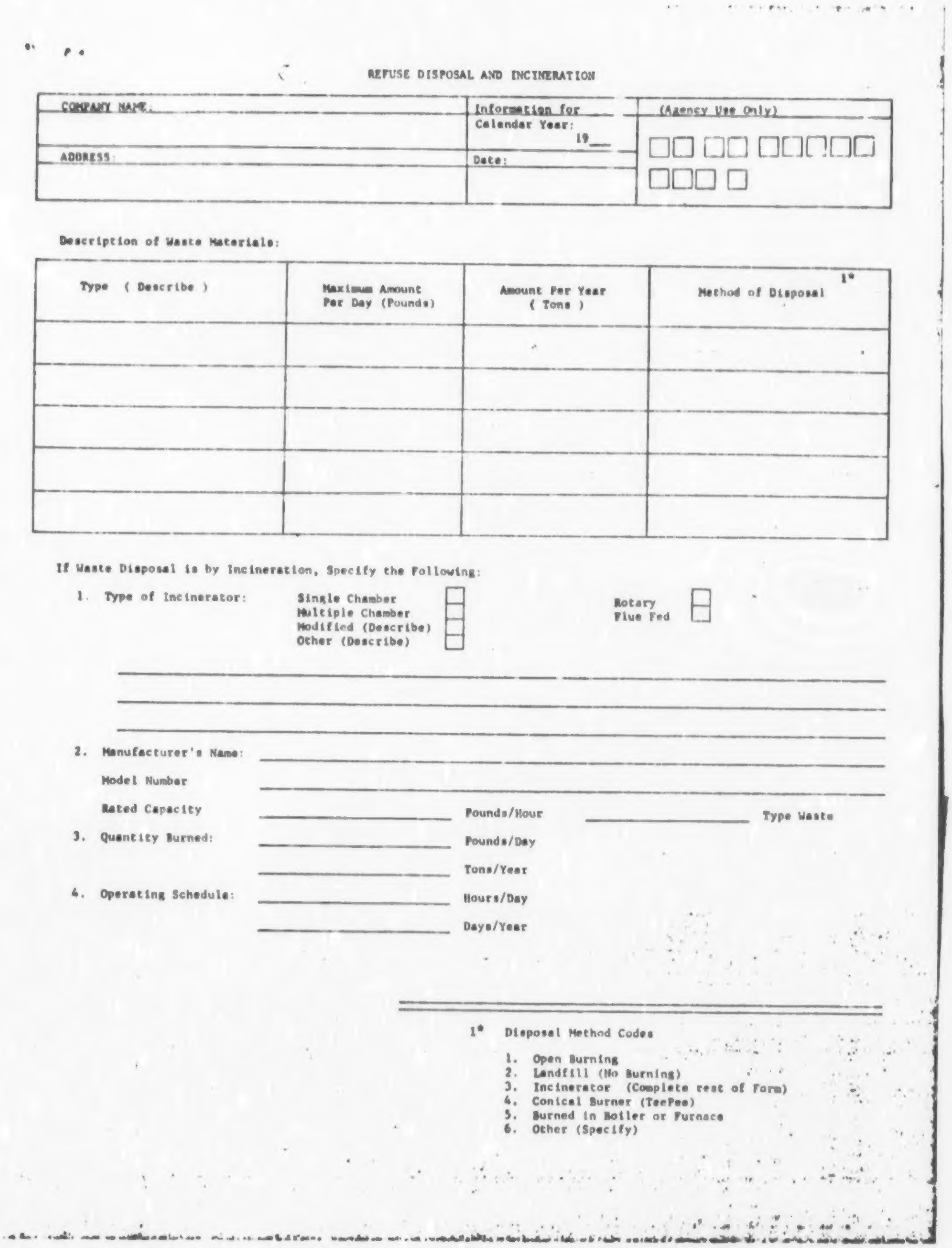
Exit Gas Volume ________________ SCFM

Exit Gas Temp. ________________ ° F

8. Estimated Emissions From Refuse Incineration:

Name:			Basis of Estimate:
Particulates	________	Tons/Year	________
Sulfur Oxides	________	"	________
Carbon Monoxide	________	"	________
Hydrocarbons	________	"	________
Nitrogen Oxides	________	"	________

Figure C-2-10 (cont'd.)



REFUSE DISPOSAL AND INCINERATION

COMPANY NAME:	Information for Calendar Year: 19__	(Agency Use Only)
ADDRESS:	Date:	☐☐ ☐☐ ☐☐☐☐☐ ☐☐☐ ☐

Description of Waste Materials:

Type (Describe)	Maximum Amount Per Day (Pounds)	Amount Per Year (Tons)	Method of Disposal 1*

If Waste Disposal is by Incineration, Specify the Following:

1. Type of Incinerator: Single Chamber ☐ Multiple Chamber ☐ Modified (Describe) ☐ Other (Describe) ☐ Rotary ☐ Flue Fed ☐

2. Manufacturer's Name: ______

Model Number ______

Rated Capacity ______ Pounds/Hour ______ Type Waste

3. Quantity Burned: ______ Pounds/Day

______ Tons/Year

4. Operating Schedule: ______ Hours/Day

______ Days/Year

1* Disposal Method Codes

1. Open Burning
2. Landfill (No Burning)
3. Incinerator (Complete rest of Form)
4. Conical Burner (TeePee)
5. Burned in Boiler or Furnace
6. Other (Specify)

Figure C-2-10 Example Industry-Specific Questionnaire for Refuse Disposal and Incineration

CARBON BLACK

1. QUANTITY OF CARBON BLACK PRODUCED DURING CALENDAR YEAR ______________ TONS

2. CHECK TYPE OF PROCESS:

   CHANNEL BLACK ________ THERMAL BLACK ________ OTHER (SPECIFY) ______________

3. CHECK TYPE OF FURNACE: OIL FIRED ______ GAS FIRED ______

4. WEIGHT PERCENT SULFUR IN FUEL ______%

5. WEIGHT PERCENT SULFUR IN FLUE GAS AS: 1) H_2S ______% 2) SO_2 ______%

6. OVERALL COLLECTION EFFICIENCY OF CONTROL EQUIPMENT IN FURNACE PROCESS ______%

7. IF THERMAL BLACK PROCESS, CHECK USE OF EXIT GAS:

   RECYCLED TO STEAM BOILERS ____________

   RECYCLED TO PROCESS BURNERS ____________

8. DESCRIBE ALL PROCESS OPERATIONS AT THIS LOCATION

Figure C-2-9 Example Industry-Specific Questionnaire for Carbon Black Manufacturing

ASPHALT ROOFING

1. QUANTITY OF ASPHALT INPUT TO PROCESS ______________________________ TONS

2. AMOUNT OF SATURATED FELT PRODUCED __________________________________ TONS

3. CHECK PERCENTAGES USED FOR FELT SATURATION:

DIPPING ONLY __________ % SPRAYING ONLY __________ % DIPPING AND SPRAYING __________

4. CHECK CONTROL EQUIPMENT USED:

		NUMBER OF UNITS
A. LOW VOLTAGE PRECIPITATOR	_____	_________
B. SCRUBBER	_____	_________
C. SCRUBBER IN COMBINATION WITH PRECIPITATOR	_____	_________
D. CYCLONES	_____	_________
E. FABRIC FILTERS	_____	_________
F. OTHER (SPECIFY)	_____	_________
_______________________		

5. DESCRIBE NEW ABATEMENT EQUIPMENT PROPOSED: (CONTINUE ON ADDITIONAL PAGE IF NECESSARY)

TYPE ___________________________ PROPOSED OPERATIONAL DATE (MO/YR) _________________

6. DESCRIBE ALL PROCESS OPERATIONS AT THIS LOCATION

_____________________ ________

Figure C-2-8 Example Industry-Specific Questionnaire for Asphalt Roofing

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☐☐☐ ☐

Reference Number	Air Pollution Control Equipment				Emission Rates						Basis of Estimates
	Manufacturer and Model Number	Type (Use Codes) 3*	Efficiency		Particulate	Sulfur Oxides	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides	Others (Identify)	
			Design %	Actual %	(Give in Units of Tons per Year)						

3* Control Equipment Identification Codes

1. Settling Chamber
2. Cyclone
3. Multicyclone
4. Wet Centrifugal Scrubber
5. Wetted Baffle Scrubber
6. Impingement Scrubber
7. Venturi Scrubber
8. Electrostatic Precipitator
9. Baghouse (Fabric Filter)
10. Afterburner(s)
11. Other (Specify)

For Wet Scrubbers Give Gallons per Minute Water Flow and Water Pressure If Known.

Figure C-2-7 (cont'd.)

PAGE 2

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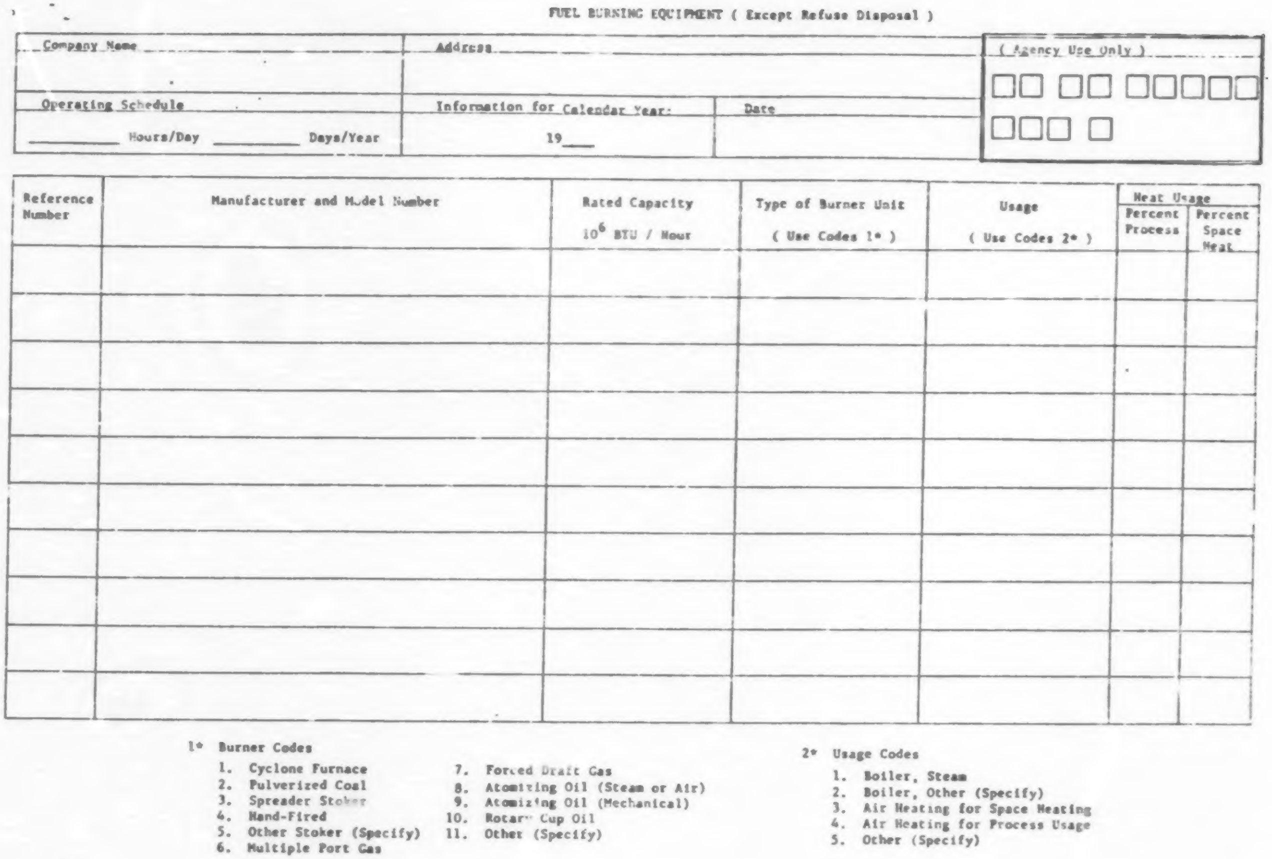
Reference Number	Stack Parameters				Fuel Data					
	Stack Height Feet	Inside Exit Dia. Feet	Exit Gas Velocity Feet/Sec.	Exit Gas Temperature Degrees F	Fuel Type	Maximum Amount per Hour (Specify Units)	Amount per Year (Specify Units)	Heat Content BTU/Gal,etc. (Specify Units)	Percent Sulfur	Percent Ash

FUEL SUPPLIERS:

Fuel Type	Supplier

Figure C-2-7 (cont'd.)



FUEL BURNING EQUIPMENT (Except Refuse Disposal)

Company Name	Address		(Agency Use Only) ☐☐ ☐☐ ☐☐☐☐☐ ☐☐☐ ☐
Operating Schedule ________ Hours/Day ________ Days/Year	Information for Calendar Year: 19___	Date	

Reference Number	Manufacturer and Model Number	Rated Capacity 10^6 BTU / Hour	Type of Burner Unit (Use Codes 1*)	Usage (Use Codes 2*)	Heat Usage	
					Percent Process	Percent Space Heat

1* Burner Codes

1. Cyclone Furnace
2. Pulverized Coal
3. Spreader Stoker
4. Hand-Fired
5. Other Stoker (Specify)
6. Multiple Port Gas
7. Forced Draft Gas
8. Atomizing Oil (Steam or Air)
9. Atomizing Oil (Mechanical)
10. Rotary Cup Oil
11. Other (Specify)

2* Usage Codes

1. Boiler, Steam
2. Boiler, Other (Specify)
3. Air Heating for Space Heating
4. Air Heating for Process Usage
5. Other (Specify)

Figure C-2-7 Example Industry-Specific Questionnaire for Fuel Burning Equipment

ELECTRICAL, ELECTRONIC AND SCIENTIFIC MANUFACTURE

PROCESS	MATERIALS USED (YEARLY CONSUMPTION)	AIR POLLUTION CONTROL DEVICES (SPECIFY TYPE AND EFFICIENCY)
DEGREASING:	SOLVENT USED________ SOLVENT QUANTITY______Gal/Year	
CHEMICAL MILLING ETCHING OR ENGRAVING:	SOLUTION COMPOSITION____________ MASKING TYPE______ APPLICATION METHOD__________ MASKING QUANTITY________ $\frac{\text{Gal}}{\text{Year}}$ SOLUTION QUANTITY________ $\frac{\text{Gal}}{\text{Year}}$	
SOLDERING:	TYPE FLUX________ FLUX QUANTITY________Tons/Year	
WELDING:	GAS USED________ ELECTRODES________Tons/Year	

Figure C-2-6 (cont'd.)

ELECTRICAL, ELECTRONIC AND SCIENTIFIC EQUIPMENT MANUFACTURE

PROCESS	MATERIALS USED (YEARLY CONSUMPTION)	AIR POLLUTION CONTROL DEVICES (SPECIFY TYPE AND EFFICIENCY)
COATING: (OTHER THAN PAINT)	SPRAY? ________ BATH? ________ COATING SOLUTION CHEMICAL COMPOSITION ________ QUANTITY ________ GAL/YEAR ________ ________	

PAINTING

TYPE (SPECIFY SOLVENT)	ADSORBER	WATER CURTAIN	AFTER-BURNER	FILTER PAD	OTHER (SPECIFY)	QUANTITY USED GAL/YEAR
PRIMER:						
PAINT:						
ENAMEL:						
OTHER (SPECIFY)						

DESCRIBE ALL PROCESS OPERATIONS AT THIS LOCATION

Figure C-2-6 Example Industry-Specific Questionnaire for Electrical, Electronic, and Scientific Equipment Manufacture

METAL PRODUCTION

INCLUDE IN YOUR REPORT:

1. A COMPLETE DESCRIPTION OF EACH PROCESS INCLUDING, BUT NOT LIMITED TO, ORE UNLOADING, ORE PREPARATION, REFINING, ALLOYING, ETC.

2. THE CHEMICAL COMPOSITION OF YOUR MATERIAL: ORE, FLUXES, ALLOYING MATERIAL, ETC.

PLEASE ANSWER THE FOLLOWING QUESTIONS:

1. WHAT PERCENT OF THE BLAST FURNACE WASTE GASES IS USED FOR FUEL? _______%

2. WHAT IS THE AVERAGE WEIGHT % SULFUR CONTENT IN THE COAL OR COKE USED? _______%

DESCRIBE ALL PROCESS OPERATIONS AT THIS LOCATION

Figure C-2-5 (cont'd.)

METAL PRODUCTION

PROCESS	MATERIALS USED (YEARLY CONSUMPTION)	AIR POLLUTION CONTROL DEVICES (SPECIFY TYPE AND EFFICIENCY)
PLATING, DIPPING, GALVANIZING, COATING (OTHER THAN PAINT)	MATERIAL BEING SPRAYED ________ QUANTITY SPRAYED ________ tons/year	
	COATING SOLUTION CHEMICAL COMPOSITION ________ QUANTITY ________ gals/year	

PAINTING

TYPE (SPECIFY SOLVENT)	ADSORBER	WATER CURTAIN	AFTER-BURNER	FILTER PAD	OTHER (SPECIFY)	QUANTITY USED GAL/YEAR
PRIMER:						
PAINT:						
ENAMEL:						
OTHER (SPECIFY)						

****

IF YOUR COMPANY HAS ANY OTHER PROCESSES, SUCH AS FRIT SMELTING, METAL REFINING, ALLOYING, PRODUCTION OF NON-METAL PARTS, ETC., DESCRIBE THESE ON PAGE 5.

Figure C-2-5 (cont'd.)

SIC Codes (Standard Industrial Classification Codes): A series of codes devised by the Office of Management and Budget to classify establishments according to the type of economic activity in which they are engaged.

SIP (State Implementation Plan) inventories: Emission inventories required as part of the overall State Implementation Plan for achieving the National Ambient Air Quality Standards. Such plans are required to be submitted by the States to the U.S. Environmental Protection Agency under the Clean Air Act.

solvent: Any (generally liquid) organic compound that is used to dissolve another compound or group of compounds.

source: Any person, device, or property that contributes to air pollution.

source category: Any group of similar sources. For instance, all residential dwelling units would constitute a source category.

source (process) information: That information collected on each point source in an inventory that describes what kind of source it is, location, fuel use and fuel characteristics, operational data, stack data, etc. Source information, together with emissions and control device data, comprise the basic elements of an emission inventory. For area sources, this information is usually limited to activity levels.

source/receptor model: A model or relationship that predicts ambient oxidant levels based on precursor emission strengths (of NO_x and VOC) and various meteorological parameters. Source/receptor models may range in complexity from simple empirical or statistical relationships (such as rollback or the Empirical Kinetics Modeling Approach [EKMA]) to detailed photochemical atmospheric simulation models (such as the SAI urban airshed model).

source test: Direct measurement of pollutants in the exhaust stream(s) of a facility.

spatial resolution: The degree to which a source can be pinpointed geographically in an emission inventory.

species information: Data on the individual volatile organic compounds present in the emissions from a source.

stationary source: Any source with a permanently fixed location.

surface coating: Operations involving the application of paints, varnishes, lacquers, inks, fabric coatings, adhesives, etc. Emissions of organics compounds result when the volatile portion of the coating evaporates.

temporal resolution: A measure of the smallest time interval with which emissions can be associated in an inventory.

vehicle speed adjustment factor: The ratio of the pollutant exhaust emission factor at any given speed to the pollutant exhaust emission factor as determined by the 1975 Federal Test Procedure (19.6 miles per hour).

VMT (vehicle-miles traveled): An indication of motor vehicle activity in an area.

Volatile organic compounds (VOC): Any hydrocarbons or hydrocarbon derivatives that are readily vaporized at typical conditions.

Appendix B

1.0 NEDS

The National Emissions Data System is a computerized data handling system which accepts, stores and reports on source and emissions information relating to sources of any of the five criteria pollutants (particulates, SO_x, NO_x, CO, and hydrocarbons). In NEDS, a major distinction is made between two types of sources: point sources and area sources. Point sources, in the broadest sense, are stationary sources large enough to be identified and tracked individually; although, per EPA reporting requirements (CFR 40 Part 51), they are any plants that emit more than 100 tons/year of any of the criteria pollutants. Area sources, on the other hand, are those stationary and mobile sources which individually emit much less than 100 ton/year and are too small and too numerous to keep individual records on. Area sources are considered collectively on a county basis. A large boiler within a power plant would be an example of a point source, whereas a single automobile is an example of the type of source considered collectively as an area source.

In NEDS, all source-related data are entered into the system via specially formulated point and area source coding forms and are stored in separate point and area source files. Data stored in the system for point and area sources are briefly described below.

Point Source Data
- General source information - Name, address, types of source, year of record, comments, etc.

Emissions data - Operating or production rate, estimated emissions, EPA calculated emissions, control device type and efficiency on each criteria pollutant, etc.

Modeling parameters - UTM coordinates of source, stack height, and diameter, exhaust gas temerpature, and flow rate, etc.

Area Source Data

General source information - Name and location of area (county) source, population, year of record.

Activity levels - Countywide activity level of each type of area source (*e.g.*, tons of coal burned in all domestic space heating equipment in a county).

Emissions data - Emission estimates for the entire county (for each pollutant) as well as for each area source category.

Currently in NEDS, information is being maintained on over 100,000 point sources and about 3,200 area (county or or county equivalent) sources in the 55 states and territories of the United States. The point source total will fluctuate as additional sources are reported, new sources come into operation, or old sources cease operations, whereas the number of area sources is fixed by the number of counties in the United States.

The information contained in these files changes too. As plants add to, modify, or change the operation of their equipment, utilize different fuels, etc., the point source data must be continually updated to reflect these changes.

Likewise, as the activity levels of the various area sources change (*e.g.*, more vehicle-miles may be traveled by automobiles in a county, more oil and less gas may be burned for home heating, etc.) their records must likewise be updated. It is the responsibility of the states (as required by the abovementioned Federal regulations) to maintain the point source data. Area source data, because of their composite nature, are collected, apportioned, and maintained centrally by EPA, although state-supplied data will be accepted if they are more accurate and adequately documented. All data submitted are edited and validated prior to being accepted into the system. In addition to the point and area source files, emission factor files are maintained current with the latest AP-42 information as a part of NEDS.

The most important function of NEDS is report generation. Output reports obtainable from NEDS range from reports on individual point and area sources to sophisticated summary reports which aggregate the data in a variety of ways and condense the data from many sources into one report. Also, because of the file design employed in NEDS, numerous selection and sorting criteria can be specified by the user of the system.

The following describes the more important reports available from NEDS. This is not a complete list since NEDS is continually being expanded to facilitate additional user needs.

Complete point or area source listing - These reports include, in a standard format, all of the source and emissions data stored in NEDS for individual point or area sources. This includes all of the data supplied to NEDS on point and area source input forms as well as any emission estimates calculated by EPA through the use of emission factors.

Condensed point source listing - This report yields an abbreviated listing of data items for each point source, including the plant name, location, control device (and efficiency thereof) and the emissions associated therewith.

Emissions summary report - This report outputs, for a specified geographical area, emissions of each of the criteria pollutants associated with all of the source categories represented in NEDS as well as the total emissions for all source categories.

Area source fuel summary listing - This report shows the amounts of various types of fuels consumed by major user categories (residential, commercial/institutional, and industrial) for a specified geographical area. This summary includes area source records only.

Plant emissions report - This report presents a listing of the names of plants in NEDS and the emissions associated with each plant.

Fuel summary listing - This report shows the fuel amounts consumed by all stationary and mobile source categories for a specified geographical area. This report includes both point and area source records.

SCC (Source Classification Code) emissions report - This report shows each SCC, the number of times that SCC occurs within a specified geographical area, and the total emissions for each of the five pollutants associated with each SCC. (Note that an SCC is a code used in NEDS to represent different kinds of point source categories.)

NEDS is currently operational on a UNIVAC 1110 located at Research Triangle Park, NC. It is accessible in the batch and remote batch modes by EPA headquarters and regional personnel. The system is not routinely available to users as a software package to be run on their own computers. However, descriptions, flow charts, and other documentation are available in the AEROS Manual Series publications that are obtainable from EPA to qualified requesters or, alternately, from the National Technical Information Center (NTIS - U.S. Dept. of Commerce), Arlington, Va. Consult the AEROS/NEDS contact in the appropriate EPA Regional Office for further details and assistance in obtaining the proper publications and information.

2.0 The Emissions Inventory System/Permits and Registration Subsystem (EIS/P & R) of the Comprehensive Data Handling System (CDHS)

The Comprehensive Data Handling System (CDHS) is a data handling system concept intended to aid State and local air pollution control agencies in performing their daily operations and to ease their job of meeting Environmental Protection Agency (EPA) reporting requirements.

The CDHS is actually comprised of two basic and major subsystems which may be operated independently of each other. These subsystems are:

The Emissions Inventory/Permits and Registration Subsystem (EIS/P&R)

The Air Quality Data Handling Subsystem - II (AQDHS-II)

The CDHS subsystems (software) are provided to State and local air pollution control agencies at no charge. Each agency installs the subsystems on a computer to which it has access; and the agency can then build and maintain its own data bases. The computer programs which comprise each subsystem are maintained by EPA. Of these, EIS/P&R is of interest in the context of emission inventories.

EIS/P&R subsystem provides a means for monitoring point and area source engineering and emissions data. It has special capabilities for recording permit data and can handle narrative information such as rules and regulations. EIS/P&R also provides means for handling special data of local importance while maintaining full compatibility (for reporting purposes) with Federal requirements. EIS/P&R is especially significant since it can be used to support such agency activities as permit control, source inventory, legal actions, and the monitoring and recording of enforcement and inspection activities. A simplified diagram of the basic concept of EIS/P&R is shown in Figure B.2-1

The interested agency should consult the appropriate EPA Regional Office for more information on what EIS/P&R can do or how to obtain it. It may also contact the National Air Data Branch, Research Triangle Park, N.C. 27711.

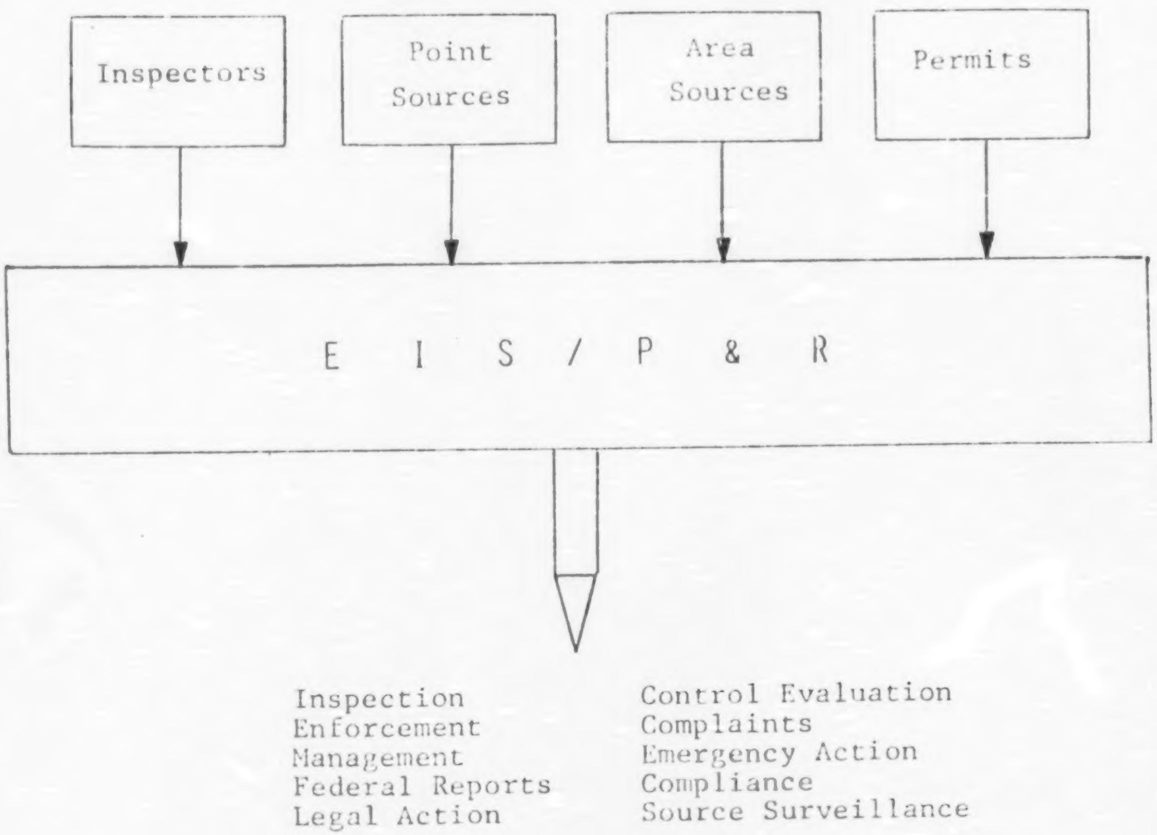

Inspectors
Point Sources
Area Sources
Permits
E I S / P & R
Inspection
Enforcement
Management
Federal Reports
Legal Action
Control Evaluation
Complaints
Emergency Action
Compliance
Source Surveillance

Figure B.2-1 EIS/P&R Concept

Appendix C

This appendix contains example questionnaires that have been used by various agencies in the completion of organic emission inventories. A general discussion of the design and use of questionnaires is presented in Chapter 4. The inclusion of these questionnaires does not imply an endorsement by EPA or a requirement to use them. They are presented merely to show the basic structure and content possible and the various alternatives available.

Several kinds of questionnaires are included herein. Section C-1 of this appendix presents one type of general questionnaire that the agency may consider employing when it does not have sufficiently detailed information about each source to warrant using industry-specific questionnaires. It should be noted that most general VOC questionnaires focus primarily on evaporative sources although some provision is commonly made for various manufacturing industries. General evaporative questionnaires may not be appropriate for some non-evaporative processes such as combustion and incineration. Thus, in cases where the agency is not certain of the extent of the various activities at a particular facility, it may consider attaching a fuel combustion and refuse incineration questionnaire in the general questionnaire package. (Examples of these are presented in Section C-2.)

Section C-2 includes examples of industry-specific questionnaires that can be employed in cases where the agency is familiar with the operations of a given facility and can be certain that a particular questionnaire is appropriate. To avoid redundancy, cover letters and instruction sheets have not been included with each questionnaire. Also, industry-specific questionnaires are not included for all types of industries. Some source categories are so unique and/or complex that it would be extremely difficult and resource-intensive to develop industry-specific questionnaires for each industry therein. For example, the broad category of chemical manufacturing encompasses so many different products and processes (each process often unique from another process, even when manufacturing the same product) that designing specific questionnaires for each process/product combination may be out of the question for some agencies. Finally, because some of the industries for which specific questionnaires have been included emit other pollutants than organics, information is generally solicited that allows an agency to obtain emission estimates for these other pollutants,as well. Hence, all of the data items on certain questionnaires may not pertain to organic emissions.

Section C-3 lists several example questionnaires that can be used to obtain area source information directly. It is generally preferable if the agency can determine local activity levels for area sources through the use of questionnaires or field surveys rather than rely on aggregated data in various publications. Those source categories represented in Section C-3 do not constitute all area sources for which questionnaires could be employed. Rather, several examples are presented to demonstrate the concept of using questionnaires for area sources so that the agency may, if it has the resources, develop appropriate questionnaires for the important area sources in the survey area.

APPENDIX C

SECTION C-1

AN EXAMPLE GENERAL QUESTIONNAIRE

Official Use
Rec.by __________ Date ______
SIC _____ Plant Id.No. _____

BEFORE FILLING OUT THE QUESTIONNAIRE
PLEASE READ THE FOLLOWING INSTRUCTIONS:

- Everyone receiving this form should complete Section I (General Information) and all other sections pertaining to their firm.
- Indicate any change in name and/or address in Section I. Please make sure to include county name.
- The information submitted should pertain to the calendar year of 19__
- The questionnaire was designed for a wide variety of operations which involve extensive solvent usage. Accordingly, many questions may not apply to your facilities. PLEASE COMPLETE ONLY THOSE SECTIONS THAT ARE APPLICABLE TO YOUR OPERATIONS.
- If the space provided is not adequate, feel free to either copy the form, use a separate sheet or request an additional copy.

Your cooperation in filling out this form is greatly appreciated. It is anticipated that some of the data requested for your operations will not be available. Please supply as much information as possible to allow accurate calculations to be made and a representative inventory to be conducted. If you have any questions concerning this questionnaire feel free to contact the individual(s) listed on the enclosed cover letter.

Figure C-1-1. Example General Questionnaire

I. GENERAL INFORMATION

1. Company Name____

Plant Address________________ City________ Zip Code____ County______ State______

Mailing Address________________ City________ Zip Code____ County______ State______

2. Person to contact about form____________________________

Telephone__________________ Title__________________

3. Approximate number of employees______

4. Nature of Business____

____

____

5. **Normal Operating Schedule**

______ Hrs./day ______ days/wk. ______ wks./yr.

6. Approximate Percent Seasonal Operation:

Dec.-Feb.	March-May	June-Aug.	Sept.-Nov.

7. How much do you anticipate your growth will increase by the year ______1980; ______1985.

8. Are volatile organic or solvent-containing materials such as cleaning fluids, coatings, adhesives, inks, etc. used in your operation?

____ YES ____ NO

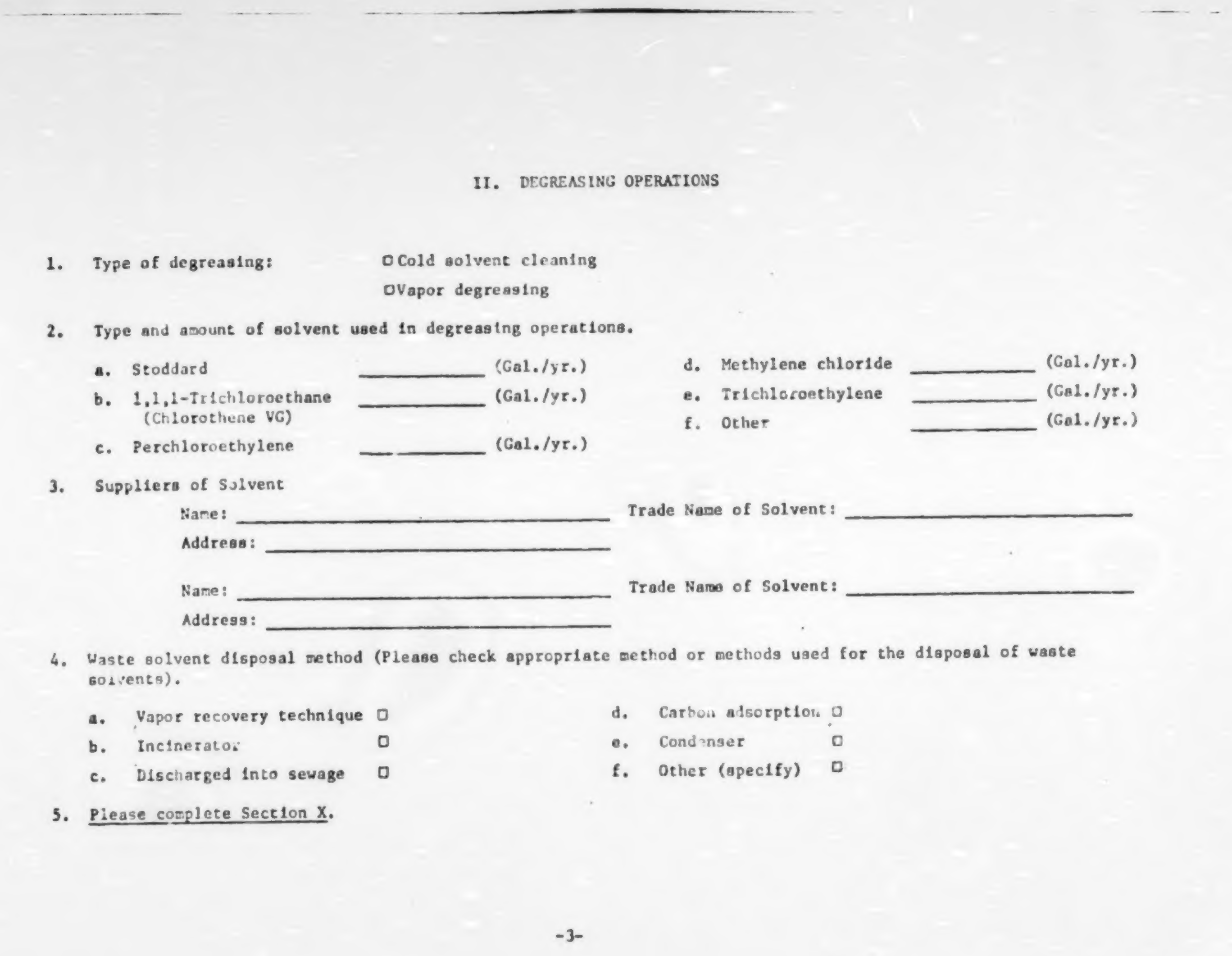
If NO, sign form and return.

If YES, sign form and complete only the sections pertaining to your operations.

Signature __________________ Date__________________

-2-

Figure C-1-1 (cont'd.)



II. DEGREASING OPERATIONS

1. Type of degreasing: ☐ Cold solvent cleaning
   ☐ Vapor degreasing

2. Type and amount of solvent used in degreasing operations.
   - a. Stoddard ____________ (Gal./yr.)
   - b. 1,1,1-Trichloroethane (Chlorothene VG) ____________ (Gal./yr.)
   - c. Perchloroethylene ____________ (Gal./yr.)
   - d. Methylene chloride ____________ (Gal./yr.)
   - e. Trichloroethylene ____________ (Gal./yr.)
   - f. Other ____________ (Gal./yr.)

3. Suppliers of Solvent

   Name: ______________________ Trade Name of Solvent: ______________________

   Address: ______________________

   Name: ______________________ Trade Name of Solvent: ______________________

   Address: ______________________

4. Waste solvent disposal method (Please check appropriate method or methods used for the disposal of waste solvents).
   - a. Vapor recovery technique ☐
   - b. Incinerator ☐
   - c. Discharged into sewage ☐
   - d. Carbon adsorption ☐
   - e. Condenser ☐
   - f. Other (specify) ☐

5. Please complete Section X.

-3-

Figure C-1-1 (cont'd.)

III. FABRIC OR RUBBERIZED COATING APPLICATIONS

1. Coating Information:

Source No.*	Material Being Coated	State Coating Process: Impregnation, Saturation, "Wet" Coating, Hot Melt Coating, Lamination, or other (specify)	Type of Coating**	Amount of Coating (Gal/yr)	Solvent added to Coating	
					Type***	Amount (Gal/yr)
	Textile Fabrics					
	Rubberized Fabrics					
	Insulating Tapes					
	Pipe Wrap					
	Other Products (specify)					

2. Type*** and amount of solvent used for surface preparation, dilution and cleaning not included above:
   Type __________, Amount __________ (Gal/yr); Type __________, Amount __________ (Gal/yr)
3. Is any solvent returned to suppliers or collector? _____NO _____ YES
   Type*** __________, Amount __________ (Gal/yr)
4. Please complete Section X; use same Source No.

---

*A source is an individual or similar pieces of equipment such as coaters, dryers, etc.

**Polyvinyl chloride, polyurethanes, rubber, cellulose derivatives, acrylic, polyester, olefinic, epoxy or silicon adhesive, other (specify).

***Toluene, naphtha, mineral spirits, MEK, xylene, chlorinated hydrocarbon, other (specify).

Figure C-1-1 (cont'd.)

IV. PROTECTIVE OR DECORATIVE COATINGS OTHER THAN FABRIC COATING

1. Indicate material(s) being coated* ______________________________

2. Process information:

Source** No.	Indicate Application Method: Spraying, Dipping, Roller, Flow, Brushing, etc.	Type of Coating ***	Density of Coating (Lb/Gal)	Amount (Gal/yr)	Solvents Added to Coating		
					Type****	%	Amount (Gal/yr)

3. Type**** and amount of solvent used for surface preparation, dilution, and cleaning not included above:

Type __________, Amount __________ (Gal/yr)
Type __________, Amount __________ (Gal/yr)

4. Please complete Section X; use same Source No.

---

*Automobiles, machinery, structures, etc.

**A source is an individual or similar pieces of equipment such as spray booths, tanks, dryers, etc.

***(1) paint, (2) varnish/shellac, (3) lacquer, (4) enamel, (5) primer, (6) other (specify)

****Acetone, isopropyl alcohol, MEK, butyl acetate, cellusolve, toluene, etc.

Figure C-1-1 (cont'd.)

V. PRINTING

1. Material(s) being coated* ______________________________

2. Process information:

Source No.**	Indicate Printing Process: Letterpress, Flexographic, Lithographic, Gravure, Screen	Type of Ink***	Amount Ink Used		Solvents Used in Ink		
			Quantity	Units	Type****	%	Amount (Gal/Yr)

3. Type**** and amount of solvent used for surface preparation, dilution, and cleaning not included above:

Type __________, Amount __________ (Gal/Yr)
Type __________, Amount __________ (Gal/Yr)

4. Please complete Section X; use same Source No.

---

*e.g. newspaper, books, magazines, cartons, cans, etc.

**A source is an individual or similar printing machines, dryers, etc. It should correspond to the Source No. in Section X.

***Solvent based, oil based, lacquer type, water based, other (specify).

Figure C-1-1 (cont'd.)

VI. MISCELLANEOUS SURFACE COATING APPLICATION
(Adhesives, Paper, Leather, Films, Glass, etc.)

1. Material(s) being coated* ____

2. Process Information:

Source No.*	Indicate Coating Process: Spray, Flow, Dip, Roller, Brush, etc.	Type of Coating***	Amount of Coating (Gal/Yr)	Solvents Added to Coatings		
				Type****	%	Amount (Gal/Yr)

3. Type**** and additional amount of solvent used for surface preparation, dilution, and cleaning not included above

Type__________,Amount __________ (Gal/Yr)

Type__________,Amount __________ (Gal/Yr)

4. Please complete Section X; use the same Source No.

---

*e.g. paper treatment, leather refinishing, manufacture of magnetic tape, flourescent tubes, photographic film, etc.

**A source number is an individual or similar pieces of equipment using surface coatings.

***Adhesive type, pigment coating, barrier coating, polymeric coating, inorganic coating, other (specify).

****Branched alcohol, linear alcohol, ethyl acetate, toluene, xylene, MEK, naphtha, other (specify).

Figure C-1-1 (cont'd)

VII. MANUFACTURING INDUSTRIES

1. Brief Description of Process ______________________

2. Process Information:

Source No.*	Process or Operation Using Organic Materials**	Type of Coating Material being Applied***	Annual Coating Thruput at Source (Gal/Yr)	Solvent in Material	
				Type****	%

3. Please complete Section X, use same Source No.

---

*A source is an individual or similar pieces of equipment processing organic materials. It should correspond to the Source No. in Section X.

**Dryer, reactor, mixing tank, etc.

***Paint, varnish, shellac, lacquer, enamel, primer, adhesive, ink, other (specify)

****Acetone, MEK, butyl acetate, cellosolve, ethanol, naphtha, toluene, mineral spirits, other (specify).

Figure C-1-1 (cont'd.)

VIII. BULK SOLVENT STORAGE

Please complete the following information for each storage tank greater than 250 gallons capacity

Tank No.	Solvent Type	Capacity (Gal)	Annual Thruput (Gal/Yr)	Type of Fill and Control Equipment*

*Submerged fill, splash fill, return vent line, adsorber

Figure C-1-1 (cont'd.)

X. CONTROL AND STACK INFORMATION

Instructions:

1. A number should be assigned to each piece of equipment that emits organics or to a number of similar units that are vented to a common stack. The Source No. below should correspond to the sections previously filled out. If similar equipment have different control equipment please separate the source number as: a, b or c. (Example: 101a, 101b, 101c).
2. Identify the process or operation from which organics are emitted. For example, dry cleaner, degreasing tank, spray booth, reactor, etc. If more than one unit is emitting to a common stack, specify the number of units.
3. Identify the organics control method used such as afterburners, scrubbers, carbon adsorption, condensers, etc.
4. Indicate approximate efficiency if known.

	Source No.	Process or Operation	Organics Control Equipment	Efficiency of Control Equipment
Example:	99	Paint Mixing Tank	Adsorber	80%

Figure C-1-1 (cont'd.)

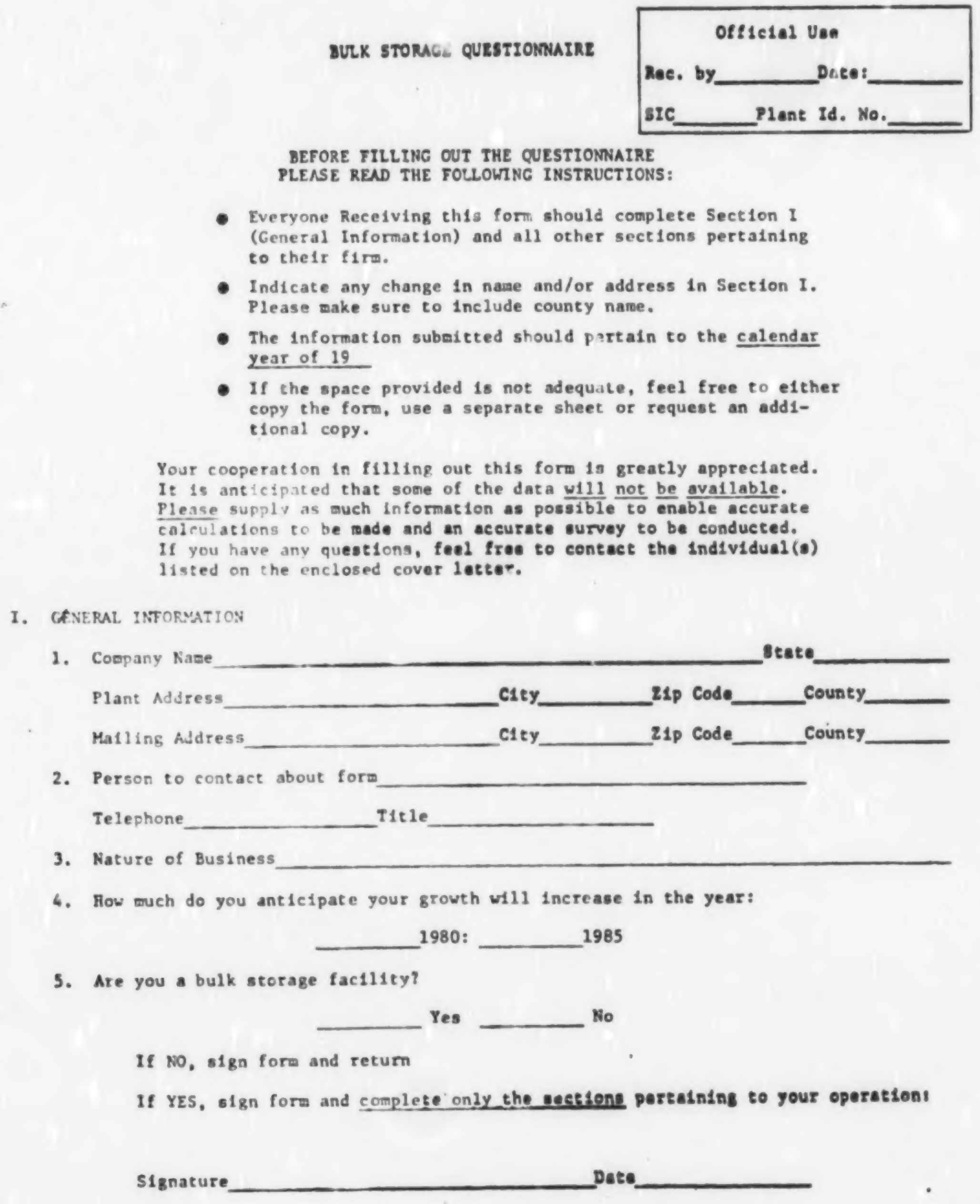
APPENDIX C

SECTION C-2

EXAMPLE INDUSTRY-SPECIFIC QUESTIONNAIRES

All questionnaires shown in this document are examples of questionnaires used by others in the past and address a specific set of needs and objectives. These questionnaires have not been examined for total compatibility with all recommendations given in various portions of this document. They should NOT be considered to be EPA recommended questionnaires.

Because questionnaires are such a key item in the conduct of an inventory, they should be developed very carefully in order to reflect the agency's specific needs in its oxidant and other programs. These questionnaires are merely intended to give examples of various types of information that may be obtained in the inventory compilation effort.



Official Use

Rec. by________Date:________

SIC_______Plant Id. No.______

BULK STORAGE QUESTIONNAIRE

BEFORE FILLING OUT THE QUESTIONNAIRE
PLEASE READ THE FOLLOWING INSTRUCTIONS:

- Everyone Receiving this form should complete Section I (General Information) and all other sections pertaining to their firm.
- Indicate any change in name and/or address in Section I. Please make sure to include county name.
- The information submitted should pertain to the calendar year of 19__
- If the space provided is not adequate, feel free to either copy the form, use a separate sheet or request an additional copy.

Your cooperation in filling out this form is greatly appreciated. It is anticipated that some of the data will not be available. Please supply as much information as possible to enable accurate calculations to be made and an accurate survey to be conducted. If you have any questions, feel free to contact the individual(s) listed on the enclosed cover letter.

I. GENERAL INFORMATION

1. Company Name______________________________**State**__________

Plant Address____________________**City**________**Zip Code**_____**County**______

Mailing Address__________________**City**________**Zip Code**_____**County**______

2. Person to contact about form______________________________

Telephone______________Title________________

3. Nature of Business______________________________________

4. **How much do you anticipate your growth will increase in the year:**

________1980: ________1985

5. **Are you a bulk storage facility?**

________ **Yes** ________ **No**

If NO, sign form and return

If YES, sign form and complete only the sections pertaining to your operation!

Signature______________________________**Date**______________

1

Figure C-2-1 Example Industry-Specific Questionnaire for Bulk Storage Tanks

STUDY AREA BULK STORAGE TANK INFORMATION   Page 1 of _____

EXAMPLE

Item No	Tank Identification No. Data	020A	
	STORED PRODUCT INFORMATION		
1.	Product stored; e.g. crude oil, gasoline, jet fuel, etc.	Jet Fuel	
2.	True vapor pressure of liquid at storage temperature (psia/°F)	4.6 psia/63°F	
3.	Reid Vapor Pressure of the Stored product (psia)	8.3	
4.	Density of product stored at storage temperature (lbs/gal)	6.2	
5.	Throughput for the year 1975 (gals/yr)	630,000,000	
	TANK INFORMATION		
6.	Tank capacity (gals)	10,500,000	
7.	Type of tank: e.g. Fixed Roof, Floating Roof, Variable Vapor Space, Pressure, Horizontal, Spherical, etc.	Floating Roof	
8.	If tank is floating roof: a) Type of roof: Double Deck/Pontoon/Other (describe) b) Type of seal: Single/Double/Other (describe) c) Type of construction: Riveted/Welded/Other (describe)	 Pontoon Double Welded	
9.	Is tank underground or aboveground	Aboveground	
10.	Tank dimensions (ft.) a) Diameter (ft-inches) b) Height (ft-inches)	 100-00 45-6	
11.	Tank shape. Cyclindrical/Spherical/Other (describe)	Cylindrical	
12.	Tank material of construction: Steel/Fiberglass/Other (describe)	Steel	
13.	Tank paint color: White/Aluminum/Light Grey/Medium Grey/Other (describe)	Aluminum	
14.	Tank condition. Good/Fair/Poor	Fair	
15.	Seal condition. Good/Fair/Poor	Poor	
16.	Average vapor space height (ft.)	26	
17.	Average wind velocity of the area (mi/hr)	11.5	
18.	Date tank installed	February, 1964	
19.	Any modifications after tank installation (describe)	Roof Seal Modified, Oct. '70	
20.	Average outage, in feet, height of vapor space including allowance for tank roof	22	
21.	Is tank equipped with vapor recovery system? Type (describe)	No	

Specify total number of fixed-roof tanks at this facility: ______________

Specify total number of floating-roof tanks at this facility: ____________   2.

Specify total number of pressure tanks at this facility: ______________

Figure C-2-1 (cont'd.)

STUDY AREA BULK STORAGE INFORMATION Page____of____

Item No					
	STORED PRODUCT INFORMATION				
1.					
2.					
3.					
4.					
5.					
	TANK INFORMATION				
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					

3.

Figure C-2-1 (cont'd.)

LOADING/UNLOADING INFORMATION Page____of____

Item No						
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
10.a						
11.						
12.						
13.						

5.

Figure C-2-1 (cont'd.)

LOADING/UNLOADING INFORMATION

EXAMPLE

Page 1 of ___

Item No.	Data \ Product Transferred*	Gasoline		
1.	Amount transferred (loading), gals/day	450,000		
2.	Amount transferred (unloading), gals/day	600,000		
3.	Amount transferred (pipe line), gals/day	None		
4.	Bulk Temperature of the product, °F	63		
5.	True vapor pressure of the product at storage temperature, psia	9.0		
6.	Reid vapor pressure of the product, psia	13.0		
7.	Molecular weight of the product, lb/lb mole	58.8		
8.	Density of the product at bulk temperature, lb/gal.	6.17		
9.	Type of loading: vessel, barge, truck, other (specify)	Truck		
10.	Type of filling: submerged, splash, top, filling, bottom filling, other (specify)	Submerged		
10.a	If submerged fill is used what approximate percent is the fill pipe submerged	60%		
11.	Is loading/unloading operation equipped with vapor recovery or other pollution control system (specify)	Yes (Vapor recovery system)		
12.	Efficiency of vapor collection system	70%		
13.	Provide additional information which might be helpful for evaluation	-		

*Crude oil, gasoline, naphtha jet fuel (JP-4), kerosene, distillate fuel, other (specify name)

4.

Figure C-2-1 (cont'd.)

PETROLEUM INDUSTRY
QUESTIONNAIRE*

1. Company Name ____________________

2. Location of Equipment (Lease or Facility Name) ____________________ City ____________________

3. Main Facility Function: Oil Field Production, Tank Farm Storage, Gas Plant, Primary Oil Treatment, other ____________________

4. Person to Contact ____________________

5. Mailing Address ____________________ Zip ____________________

6. Property Area ____________________ Acres to Nearest 1/10

QUESTIONNAIRE FORMS

I - Petroleum Product Storage

II - Petroleum Product Transfer

III - Fuel Burning Equipment

IV - Gas Compressors - Relief Valves, Seals & Flares

V - Production - Wells, Gas Traps, Seals, Water Separators, Pump Engines

* Complete one questionnaire package per facility: Tank Farm, Gas Plant, Field Production, etc.

Figure C-2-2 Example Industry-Specific Questionnaire for Petroleum Industry

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I PETROLEUM STORAGE TANK DATA *

AVERAGE DAILY TEMP. CHANGE: ____ °F

TANK NUMBER OR DESIGNATION	TANK TYPE	TANK SHAPE	TANK CAPACITY (BBLS)	DIMENSIONS DIAMETER OR LENGTH (FEET)	DIMENSIONS HEIGHT OR WIDTH (FEET)	TYPE SHELL CONST.	COLOR PAINT OR INSULA. ON SHELL	TANK MECH. CONDI-TION	TYPE OF ROOF	TYPE OF F.R. SEAL	CONDI-TION OF SEAL	PRES-SURE VENT SETTINGS (psi)	WHERE VENTED	REMARKS (I.D.)	PRODUCT	TRUE VAPOR PRES-SURE BVP (psia)	AVERAGE LIQUID BODY STORAGE TEMP. (°F)	MAXIMUM LIQUID BODY STORAGE TEMP. (°F)	AVERAGE THROUGHPUT (BBL/DAY)	TURN-OVER PER YEAR	AVERAGE OUTAGE (FT)	SP. GRAVITY STORED LIQUID

REMARKS (I.D.): ______________________________

TANK TYPE:
C = FIXED OR CONE ROOF
F = FLOATING ROOF
P = PRESSURE

TANK SHAPE:
VC = VERTICAL CYLINDER
HC = HORIZONTAL CYLINDER
S = SPHERICAL OR SPHEROIDAL
R = RECTANGULAR

TYPE SHELL CONST.:
W = WELDED
R = RIVETED
RC = RIVETED AND COATED
B = BOLTED

TYPE OF ROOF:
C = FIXED OR CONE
W = WATER SEAL
O = NO ROOF, OPEN TOP
D = DOUBLEDECK F.R.
P = PONTOON F.R.

TYPE OF F.R. SEAL:
O = NO SEAL
S = SINGLE SEAL
D = DOUBLE SEAL
T = TUBE SEAL

CONDITION OF SEAL:
DISTANCE BETWEEN FR SEAL AND TANK WALL TO NEAREST 1/10 OF AN INCH. THIS DISTANCE SHOULD BE THE SAME AT ANY POINT AROUND THE TANK.

COLOR PAINT OR INSULATION:
CW = CHALKING WHITE
AL = ALUMINUM
LG = LIGHT GRAY
D = DARK COLOR, NO PAINT OR NEEDS REPAINTING

TANK MECH. CONDITION
G = GOOD, VAPOR-TIGHT
F = FAIR, MINOR LEAKAGE
P = POOR, NEEDS REPAIR

WHERE VENTED:
A = ATMOSPHERE
V.R. = VAPOR RECOVERY
V.D. = VAPOR DISPOSAL
GB = GAS BLANKET

Figure C-2-2 (cont'd.)

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II PETROLEUM TRANSFER

A. Loading Rack(s)______________ General Pipeline______________
How many?

1. Product transferred through loading rack______________________________

   a. Maximum daily throughput during year____________GALS-BBLS/day (circle one)

   b. Actual annual throughput___________GALS-BBLS/yr (circle one)

   c. Type of vapor controls used (If none - so indicate)

   ____

2. Product transferred through loading rack______________________________

   a. Maximum daily throughput during year____________GALS-BBLS/day (circle one)

   b. Actual annual throughput_______________GALS-BBLS/yr (circle one)

   c. Type of vapor controls used (If none - so indicate)

   ____

3. Product transferred through loading rack______________________________

   a. Maximum daily throughput during year_____________GALS-BBLS/day (circle one)

   b. Actual annual throughput___________GALS-BBLS/yr (circle one)

   c. Type of vapor controls used (If none - so indicate)

   ____

B. Gasoline storage tanks used for filling company vehicles

GASOLINE STORAGE TANKS (ITEMIZE)				
Tank No.	Tank Capacity (Gal)	*Fill Pipe Distance	Gasoline Throughput (Gal/YR)	
			With Vap. Cont.	W/out Vap. Cont.
1				
2				
3				
4				
5				
6				
			Total	Total

*Actual distance between the bottom of the fill pipe and tank bottom (inches)

Figure C-2-2 (cont'd.)

III FUEL BURNING EQUIPMENT

DEVICE NUMBER	EQUIP TYPE	PRINCIP FUNCTION	PRIMARY FUEL TYPE	PRIMARY FUEL MAX INPUT RATING (BTU/HR)	PRIMARY FUEL ANNUAL FUEL USAGE	AUXILIARY FUEL TYPE	AUXILIARY FUEL MAX INPUT RATING (BTU/HR)	AUXILIARY FUEL ANNUAL FUEL USAGE	OP. SCHED. HRS/DAY	OP. SCHED. DA/YR	OP. SCHED. WK/YR	% ANN. THRPUT DEC FEB	% ANN. THRPUT MAR MAY	% ANN. THRPUT JUN AUG	% ANN. THRPUT SEPT NOV	STACK DATA HT. (FT.)	STACK DATA DIAM (FT.)	STACK DATA TEMP. (°F)	STACK DATA FLOW RT. (ACFM)

FUEL DATA		BTU CONTENT	SULFUR CONTENT BY WT.
	PRIMARY		
	AUXILIARY		

REMARKS	DEVICE #	

TYPE OF EQUIPMENT

B- INDUSTRIAL BOILER
C- COMMERC'L/INST BOILER
S- SPACE HEATER
F- FURNACE
O- OVEN

H- PETRLM HEATER/TREATER
G- PETRLM, OILFIELD STEAM GEN.
X- OTHER- USE REMARKS

PRINCIPLE FUNCTION

S- INDUSTRIAL STEAM
H- HOT WATER
D- DRYING
M- METAL TREATING
O- OIL HEATING
W- WATER SEPARATION

SH- SPACE HEAT
X- OTHER-USE REMARKS

FUEL TYPE

N- NATURAL GAS
P- PROCESS GAS
L- LPG
#1 thru #6 - #1 FUEL OIL thru #6 FUEL OIL
X- OTHER- USE REMARKS

[illegible]

Figure C-2-2 (cont'd.)

IV GAS COMPRESSORS

1. 0 - 300 HP Compressors ____________ No. of Units ____________

Fuel Gas Consumption ____________ CU FT/hr ____________ CU FT/yr

% Sulfur in Fuel Gas ____________ GRAINS/100 CU FT

Avg. Schedule of Operation ______ HR/day ______ DAY/wk ______ WK/yr

% Annual Operation ______ DEC/FEB ______ MAR/MAY ______ JUN/AUG
______ SEPT/NOV

2. 301 - 1799 HP Compressors ____________ No. of Units ____________

Fuel Gas Consumption ____________ CU FT/hr ____________ CU FT/yr

% Sulfur in Fuel Gas ____________ GRAINS/100 CU FT

Avg. Schedule of Operation ______ HR/day ______ DAY/wk ______ WK/yr

% Annual Operation ______ DEC/FEB ______ MAR/MAY ______ JUN/AUG
______ SEPT/NOV

3. 1800 HP or Over Compressors ____________ No. of Units ____________

Fuel Gas Consumption ____________ CU FT/hr ____________ CU FT/yr

% Sulfur in Fuel Gas ____________ GRAINS/100 CU FT

Avg. Schedule of Operation ______ HR/day ______ DAY/wk ______ WK/yr

% Annual Operation ______ DEC/FEB ______ MAR/MAY ______ JUN/AUG
______ SEPT/NOV

4. Total Annual Throughput of Gas Compressed ____________ CU FT/yr

5. Total Number of Compressor Seals on Compressors Handling Any Gas Containing Hydrocarbons ____________

6. Number of Relief Valves on vessels ____________

7. Number of Relief Valves on Pressurized Storage Tanks ____________

8. Number of Pipline Valves & Flanges Back to Gas Traps ____________

9. Number of Gas Flares ____________

10. Total Annual Quantity of Gas Flared ____________ CU FT/yr

11. Number of Engines Greater Than 750 HP using L.P.G. or Natural Gas ____________

Figure C-2-2 (cont'd.)

V PRODUCTION

A. WELL HEADS

1. Total Number of Wells ____________

2. Total Number of Gas Traps Systems ____________

3. Total Number of Relief Valves on Vessels ____________

4. Total Number of Pipeline Valves & Flanges ____________

5. Total Number of Well Head Seals ____________

B. Internal Combustion Engines (except compressors)

1. I.C. Engines Burning Gaseous Fuel:

a.) No. Pump Engines ____________

b.) No. Electrical Generating ____________

c.) No. other _____ Explain ____________________________

* d.) Any of the above over 750 HP? ____________ See remarks
How many?

e.) Type(s) of Fuel Gas used ____________________________

f.) Total Fuel Gas Consumption ____________ CU FT/HR ____________ CU FT/YR

2. I.C. Engines Burning Liquid Fuel:

a.) No. Pump Engines ____________

b.) No. Electrical Generating ____________

c.) No. Other _____ Explain ____________________________

* d.) Any of the above over 100 HP? ____________ See remarks
How many?

e.) Type(s) of fuel used ____________________________

f.) Total Fuel Consumption ____________ GAL/hr ____________ GAL/yr

REMARKS: (For 1.d. & 2.d. - Itemize: Actual HP - Hourly Fuel Consumption,
Type of Fuel Burned & Function of Engine

Figure C-2-2 (cont'd.)

PETROLEUM REFINING

Return to:

DATA FOR YEAR________

OFFICE USE ONLY
Rec'd by:__________
Reviewed by:__________
County:__________
Coordinates:__________
SIC No:__________

I. General Information

Firm Name____
Person to Contact________________Title__________Telephone__________
Address of Plant________________________City__________
Mailing Address________________________City__________Zip__________
Amount of Crude Processed__________Barrels/Year. Plant Capacity__________Barrels/Day.
Employees at Plant Site__________. Land Area at Site__________.
Normal Operating Schedule__________Hours/Day__________Days/Year.
Type of Sulfur Recovery System__________. Amount Removed__________. Method of Disposal___

II. Fuel Use for Generation of Heat, Power, Steam

A Source Number	B Size Unit (input)10^6 BTU/Hr	C Installation Date	D Type Fuel	E Amount Per Year	F Heat Content	G Percent Sulfur	H Height Ft.	Stack Data Dia Ft.	 Exit Velocity fps	 Exit Tmp°F

Figure C-2-3 Example Industry-Specific Questionnaire for Petroleum Refining

III. (a) Process Information

Number	Process or Operation Releasing Contaminants To Atmosphere	Materials Processed and/or Used at Operation		Control Equipment		
		Type	Quantity/Year	Type	Instal. Date	Efficiency
101	Catalytic Cracking Unit Type ________	Fresh Feed	______ Barrels			
102	Cooling Towers	Cooling Water	______ 10^6 Gals			
103	Vacuum Jets	Vacuum Feed	______ Barrels			
104	Process Drains	Waste Water	______ Barrels			
105	Compressor Int. Comb. Engines	______ Gas	______ 1000 Ft.^{3}			
106	Blowdown Systems	Emissions Will be Estimated from Plant Capacity				
107	Storage Tank Number Fixed-Roof ____ Number Floating-Roof ____	______ 10^3 Gal ______ 10^3 Gal	Total Capacity ______ 10^3 Gal ______ 10^3 Gal			

IV. (a) Emission and Stack Information for above Processes

Source No. of Process Above	Check Type				Stack Data				Emission Estimates (Tons/Year) to Atmosphere						
	Stack	Flare	Tank Farm	Fugitive Loss	Height (Ft.)	Dia. (Ft.)	Exit Velocity (fps)	Exit Temp OF	Particulates	Sulfur Oxides	Carbon Monoxide	Hydro-carbon	Nitrogen Carbon	Other	Basis of Estimate

Figure C-2-3 (cont'd.)

TIRE RECAPPING

Company Name: ______________________________

Person to Contact Regarding this Information: __________________________

Phone Number: _______________

Number of Tires Recapped in 1975:

Automobile __________

Truck __________

Amount of Rubber Dust Collected By Cyclone __________ lbs.

Amount of Adhesive Cement Used __________ Gallons.

Brand Name: __________________________

Manufacturer: __________________________

Seasonal Variation in Recapping Process

Jan,Feb,Mar	Apr,May,Jun	Jul,Aug,Sep	Oct,Nov,Dec
__________%	__________%	__________%	__________%

Figure C-2-4 Example Industry-Specific Questionnaire for Tire Recapping

METAL PRODUCTION

IF YOU HAVE ANY OF THE FOLLOWING OPERATIONS, FILL IN THE APPROPRIATE INFORMATION. IF YOU USE MORE THAN ONE METAL, COPY THESE PAGES AND FILL OUT ONE SET FOR EACH METAL.

TYPE OF METAL USED ________ ____________________

PROCESS	MATERIALS USED (YEARLY CONSUMPTION)		AIR POLLUTION CONTROL DEVICES (SPECIFY TYPE AND EFFICIENCY)
FOUNDRY: OR CASTING:	TYPE OF FURNACE ____________	AMOUNT OF METAL CAST ________ tons/year	
	COMPOSITION OF THE CHARGE ____________		
	TYPE OF BINDER FOR MOLDS ____________	QUANTITY OF BINDER ________ tons/year	
	TYPE OF CORE OVEN ____________	QUANTITY OF SAND ________ tons/year	
WELDING:	GAS USED ____________	ELECTRODES ________ tons/year	
TORCH CUTTING:	QUANTITY OF GAS ____________ cubic feet/year		
POWDER BURNING:	TYPE OF POWDER ____________	QUANTITY OF POWDER ________ tons/year	
HEAT TREATMENT:	IMPURITIES ON METAL SURFACE ____________	QUANTITY OF METAL TREATED ________ tons/year	
QUENCHING MATERIAL ________		QUANTITY OF QUENCHING MATERIAL ________ tons/year	

Figure C-2-5 Example Industry-Specific Questionnaire for Metal Production

METAL PRODUCTION

PROCESS	MATERIALS USED (YEARLY CONSUMPTION)		AIR POLLUTION CONTROL DEVICES (SPECIFY TYPE AND EFFICIENCY)
DEBURRING: OR SAND BLASTING:	TYPE OF ABRASIVE ________	QUANTITY OF ABRASIVE ________ tons/year	________
METHOD OF APPLYING ABRASIVE TO SURFACE ________			________
DEGREASING:	SOLVENT USED ________	QUANTITY OF SOLVENT ________ tons/year	________
CHEMICAL MILLING, ETCHING OR ENGRAVING:	CHEMICAL COMPOSITION OF SOLUTION ________ ________		FUME ________ ________
METHOD OF APPLYING MASKING: ________ ________	MASKING TYPE ________ MASKING QUANTITY ________ gals/year	QUANTITY OF SOLUTION ________ tons/year	MASKING ________ ________
SOLDERING:	TYPE OF FLUX ________	QUANTITY OF FLUX ________ tons/year	________
BRAZING:	TYPE OF SOLDER OR FILLER USED ________	QUANTITY OF SOLDER OR FILLER ________ tons/year	________

Figure C-2-5 (cont'd.)

METAL PRODUCTION

PROCESS	MATERIALS USED (YEARLY CONSUMPTION)	AIR POLLUTION CONTROL DEVICES (SPECIFY TYPE AND EFFICIENCY)
PLATING, DIPPING, GALVANIZING, COATING (OTHER THAN PAINT)	MATERIAL BEING SPRAYED ____________ QUANTITY SPRAYED ________ tons/year	
	COATING SOLUTION CHEMICAL COMPOSITION ____________ QUANTITY ________ gals/year	

PAINTING

TYPE (SPECIFY SOLVENT)	ADSORBER	WATER CURTAIN	AFTER-BURNER	FILTER PAD	OTHER (SPECIFY)	QUANTITY USED GAL/YEAR
PRIMER:						
PAINT:						
ENAMEL:						
OTHER (SPECIFY)						

****

IF YOUR COMPANY HAS ANY OTHER PROCESSES, SUCH AS FRIT SMELTING, METAL REFINING, ALLOYING, PRODUCTION OF NON-METAL PARTS, ETC., DESCRIBE THESE ON PAGE 5.

Figure C-2-5 (cont'd.)

METAL PRODUCTION

INCLUDE IN YOUR REPORT:

1. A COMPLETE DESCRIPTION OF EACH PROCESS INCLUDING, BUT NOT LIMITED TO, ORE UNLOADING, ORE PREPARATION, REFINING, ALLOYING, ETC.

2. THE CHEMICAL COMPOSITION OF YOUR MATERIAL: ORE, FLUXES, ALLOYING MATERIAL, ETC.

PLEASE ANSWER THE FOLLOWING QUESTIONS:

1. WHAT PERCENT OF THE BLAST FURNACE WASTE GASES IS USED FOR FUEL? _______%

2. WHAT IS THE AVERAGE WEIGHT % SULFUR CONTENT IN THE COAL OR COKE USED? _______%

DESCRIBE ALL PROCESS OPERATIONS AT THIS LOCATION

Figure C-2-5 (cont'd.)

ELECTRICAL, ELECTRONIC AND SCIENTIFIC EQUIPMENT MANUFACTURE

PROCESS	MATERIALS USED (YEARLY CONSUMPTION)	AIR POLLUTION CONTROL DEVICES (SPECIFY TYPE AND EFFICIENCY)
COATING: (OTHER THAN PAINT)	SPRAY? ____________ BATH? ____________ COATING SOLUTION CHEMICAL COMPOSITION ____________ QUANTITY ____________ GAL/YEAR ____________ ____________	

PAINTING

TYPE (SPECIFY SOLVENT)	ADSORBER	WATER CURTAIN	AFTER-BURNER	FILTER PAD	OTHER (SPECIFY)	QUANTITY USED GAL/YEAR
PRIMER:						
PAINT:						
ENAMEL:						
OTHER (SPECIFY)						

DESCRIBE ALL PROCESS OPERATIONS AT THIS LOCATION

Figure C-2-6 Example Industry-Specific Questionnaire for Electrical, Electronic, and Scientific Equipment Manufacture

ELECTRICAL, ELECTRONIC AND SCIENTIFIC MANUFACTURE

PROCESS	MATERIALS USED (YEARLY CONSUMPTION)	AIR POLLUTION CONTROL DEVICES (SPECIFY TYPE AND EFFICIENCY)
DEGREASING:	SOLVENT USED________ SOLVENT QUANTITY________Gal/Year	
CHEMICAL MILLING ETCHING OR ENGRAVING:	SOLUTION COMPOSITION________ MASKING TYPE________ APPLICATION METHOD________ MASKING QUANTITY________$\frac{\text{Gal}}{\text{Year}}$ SOLUTION QUANTITY________$\frac{\text{Gal}}{\text{Year}}$	
SOLDERING:	TYPE FLUX________ FLUX QUANTITY________Tons/Year	
WELDING:	GAS USED________ ELECTRODES________Tons/Year	

Figure C-2-6 (cont'd.)

FUEL BURNING EQUIPMENT (Except Refuse Disposal)

Company Name ____________

Address ____________

(Agency Use Only) ☐☐ ☐☐ ☐☐☐☐☐ ☐☐☐ ☐

Operating Schedule

________ Hours/Day ________ Days/Year

Information for Calendar Year: 19___

Date

Reference Number	Manufacturer and Model Number	Rated Capacity 10^6 BTU / Hour	Type of Burner Unit (Use Codes 1*)	Usage (Use Codes 2*)	Heat Usage	
					Percent Process	Percent Space Heat

1* Burner Codes

1. Cyclone Furnace
2. Pulverized Coal
3. Spreader Stoker
4. Hand-Fired
5. Other Stoker (Specify)
6. Multiple Port Gas
7. Forced Draft Gas
8. Atomizing Oil (Steam or Air)
9. Atomizing Oil (Mechanical)
10. Rotary Cup Oil
11. Other (Specify)

2* Usage Codes

1. Boiler, Steam
2. Boiler, Other (Specify)
3. Air Heating for Space Heating
4. Air Heating for Process Usage
5. Other (Specify)

Figure C-2-7 Example Industry-Specific Questionnaire for Fuel Burning Equipment

PAGE 2

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Reference Number	Stack Parameters				Fuel Data					
	Stack Height Feet	Inside Exit Dia. Feet	Exit Gas Velocity Feet/Sec.	Exit Gas Temperature Degrees F	Fuel Type	Maximum Amount per Hour (Specify Units)	Amount per Year (Specify Units)	Heat Content BTU/Gal,etc. (Specify Units)	Percent Sulfur	Percent Ash

FUEL SUPPLIERS:

Fuel Type	Supplier

Figure C-2-7 (cont'd.)

PAGE 3

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Reference Number	Air Pollution Control Equipment				Emission Rates						
	Manufacturer and Model Number	Type (Use Codes) 3*	Efficiency		Particulate	Sulfur Oxides	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides	Others (Identify)	Basis of Estimates
			Design %	Actual %	(Give in Units of Tons per Year)						

3* Control Equipment Identification Codes

1. Settling Chamber
2. Cyclone
3. Multicyclone
4. Wet Centrifugal Scrubber
5. Wetted Baffle Scrubber
6. Impingement Scrubber
7. Venturi Scrubber
8. Electrostatic Precipitator
9. Baghouse (Fabric Filter)
10. Afterburner(s)
11. Other (Specify)

For Wet Scrubbers Give Gallons per Minute Water Flow and Water Pressure If Known.

Figure C-2-7 (cont'd.)

ASPHALT ROOFING

1. QUANTITY OF ASPHALT INPUT TO PROCESS ______________________________ TONS

2. AMOUNT OF SATURATED FELT PRODUCED __________________________________ TONS

3. CHECK PERCENTAGES USED FOR FELT SATURATION:

DIPPING ONLY __________ % SPRAYING ONLY __________ % DIPPING AND SPRAYING __________

4. CHECK CONTROL EQUIPMENT USED:

		NUMBER OF UNITS
A. LOW VOLTAGE PRECIPITATOR	_____	__________
B. SCRUBBER	_____	__________
C. SCRUBBER IN COMBINATION WITH PRECIPITATOR	_____	__________
D. CYCLONES	_____	__________
E. FABRIC FILTERS	_____	__________
F. OTHER (SPECIFY)	_____	__________
____________________	__	

5. DESCRIBE NEW ABATEMENT EQUIPMENT PROPOSED: (CONTINUE ON ADDITIONAL PAGE IF NECESSARY)

TYPE ______________________________ PROPOSED OPERATIONAL DATE (MO/YR) ____________________

6. DESCRIBE ALL PROCESS OPERATIONS AT THIS LOCATION

____

Figure C-2-8 Example Industry-Specific Questionnaire for Asphalt Roofing

CARBON BLACK

1. QUANTITY OF CARBON BLACK PRODUCED DURING CALENDAR YEAR ____________________TONS

2. CHECK TYPE OF PROCESS:

CHANNEL BLACK __________ THERMAL BLACK __________ OTHER (SPECIFY) ______________

3. CHECK TYPE OF FURNACE: OIL FIRED ________ GAS FIRED ________

4. WEIGHT PERCENT SULFUR IN FUEL __________%

5. WEIGHT PERCENT SULFUR IN FLUE GAS AS: 1) H_2S ________% 2) SO_2 ________%

6. OVERALL COLLECTION EFFICIENCY OF CONTROL EQUIPMENT IN FURNACE PROCESS __________%

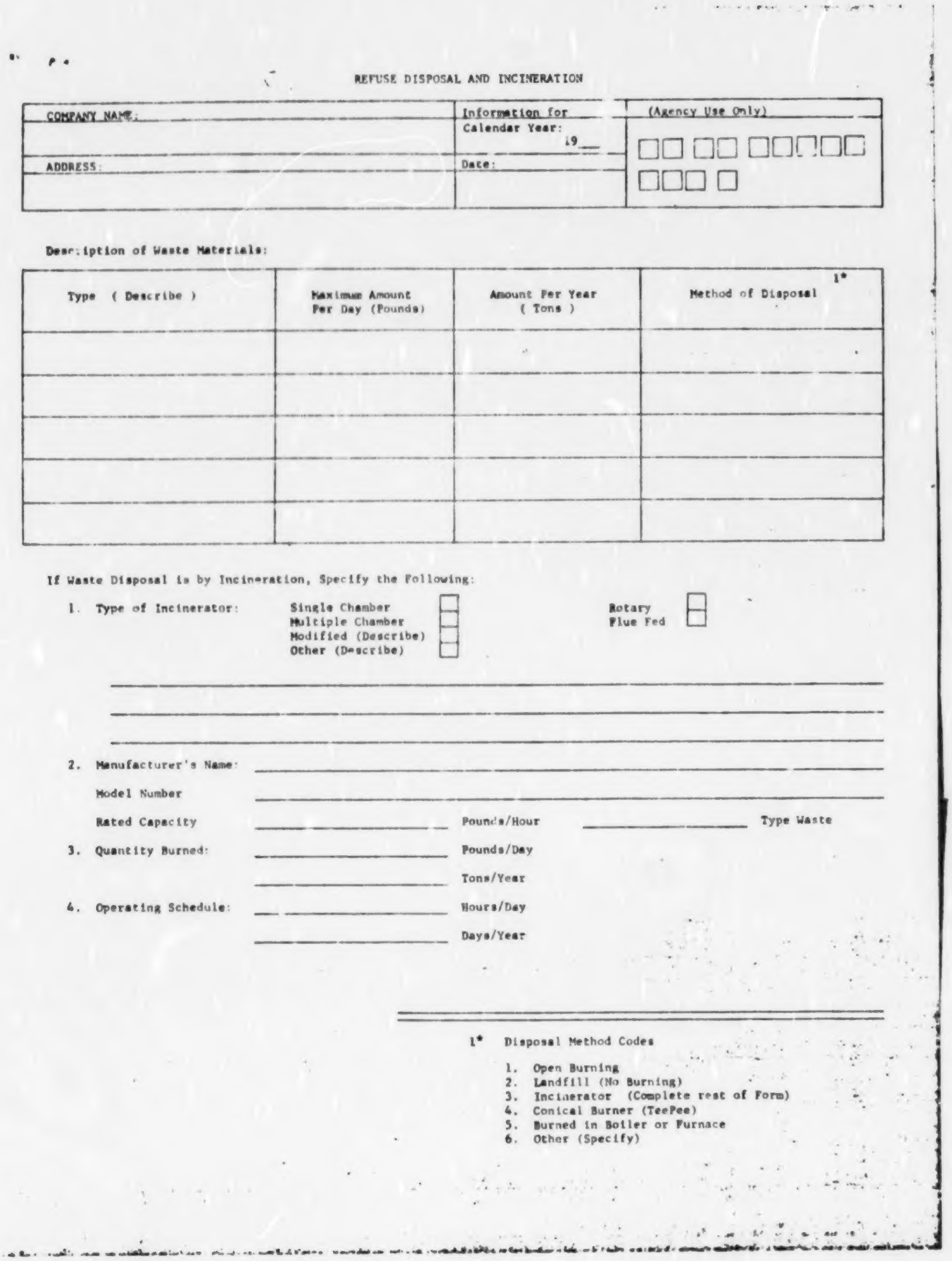
7. IF THERMAL BLACK PROCESS, CHECK USE OF EXIT GAS:

RECYCLED TO STEAM BOILERS ________________

RECYCLED TO PROCESS BURNERS ________________

8. DESCRIBE ALL PROCESS OPERATIONS AT THIS LOCATION

Figure C-2-9 Example Industry-Specific Questionnaire for Carbon Black Manufacturing



REFUSE DISPOSAL AND INCINERATION

COMPANY NAME:	Information for Calendar Year: 19__	(Agency Use Only) ☐☐ ☐☐ ☐☐☐☐☐ ☐☐☐ ☐
ADDRESS:	Date:	

Description of Waste Materials:

Type (Describe)	Maximum Amount Per Day (Pounds)	Amount Per Year (Tons)	Method of Disposal 1*

If Waste Disposal is by Incineration, Specify the Following:

1. Type of Incinerator:
   - Single Chamber ☐
   - Multiple Chamber ☐
   - Modified (Describe) ☐
   - Other (Describe) ☐
   - Rotary ☐
   - Flue Fed ☐

____

____

____

2. Manufacturer's Name: ______________________________

   Model Number ______________________________

   Rated Capacity ______________ Pounds/Hour ______________ Type Waste

3. Quantity Burned: ______________ Pounds/Day

   ______________ Tons/Year

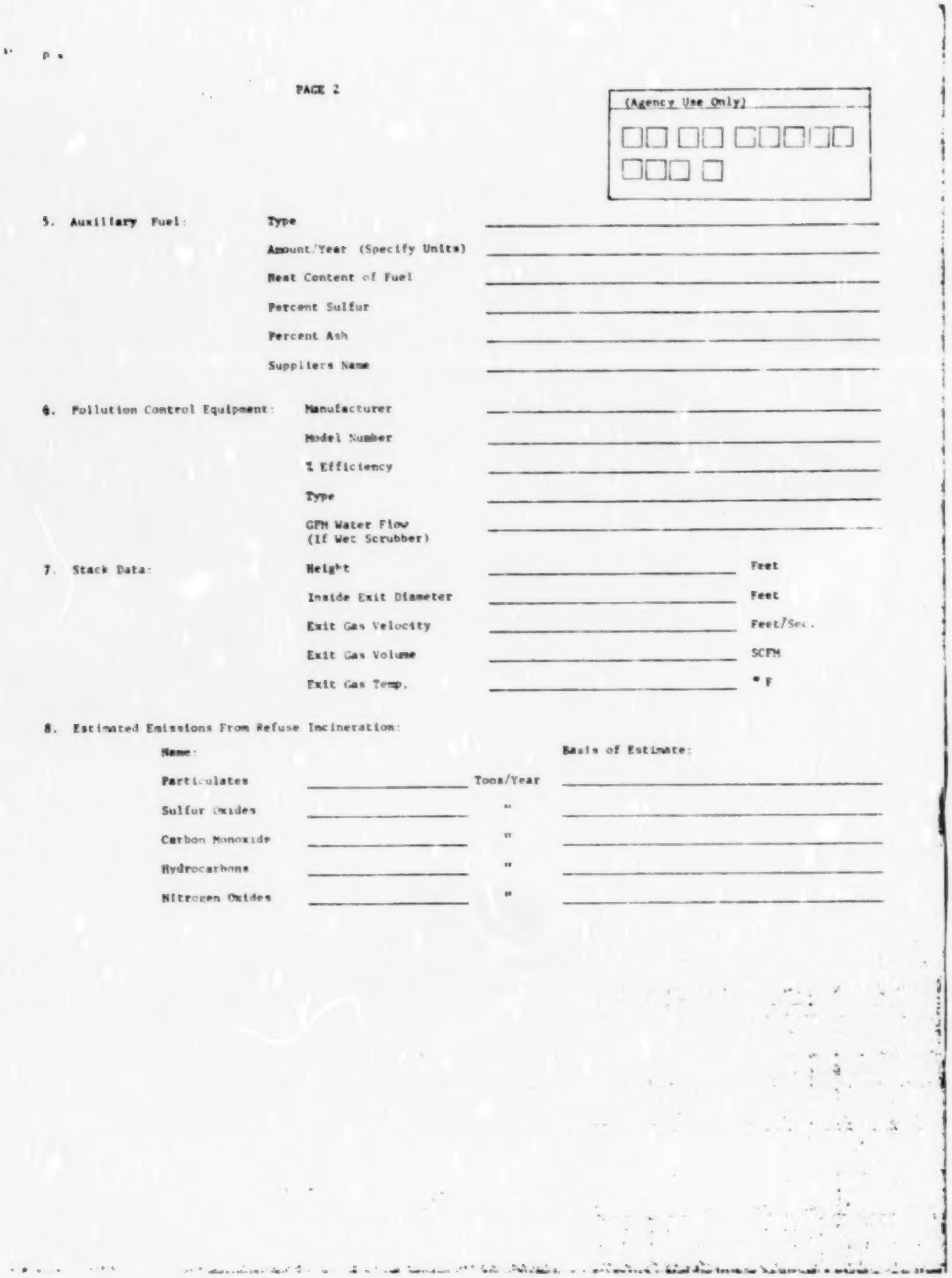
4. Operating Schedule: ______________ Hours/Day

   ______________ Days/Year

1* Disposal Method Codes

1. Open Burning
2. Landfill (No Burning)
3. Incinerator (Complete rest of Form)
4. Conical Burner (TeePee)
5. Burned in Boiler or Furnace
6. Other (Specify)

Figure C-2-10 Example Industry-Specific Questionnaire for Refuse Disposal and Incineration



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(Agency Use Only)
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5. Auxiliary Fuel:
Type ____________
Amount/Year (Specify Units) ____________
Heat Content of Fuel ____________
Percent Sulfur ____________
Percent Ash ____________
Suppliers Name ____________

6. Pollution Control Equipment:
Manufacturer ____________
Model Number ____________
% Efficiency ____________
Type ____________
GPM Water Flow (If Wet Scrubber) ____________

7. Stack Data:
Height ____________ Feet
Inside Exit Diameter ____________ Feet
Exit Gas Velocity ____________ Feet/Sec.
Exit Gas Volume ____________ SCFM
Exit Gas Temp. ____________ ° F

8. Estimated Emissions From Refuse Incineration:

Name:			Basis of Estimate:
Particulates	____________	Tons/Year	____________
Sulfur Oxides	____________	"	____________
Carbon Monoxide	____________	"	____________
Hydrocarbons	____________	"	____________
Nitrogen Oxides	____________	"	____________

Figure C-2-10 (cont'd.)

APPENDIX C

SECTION C-3

EXAMPLE AREA SOURCE QUESTIONNAIRES

All questionnaires shown in this document are examples of questionnaires used by others in the past and address a specific set of needs and objectives. These questionnaires have not been examined for total compatibility with all recommendations given in various portions of this document. They should NOT be considered to be EPA recommended questionnaires.

Because questionnaires are such a key item in the conduct of an inventory, they should be developed very carefully in order to reflect the agency's specific needs in its oxidant and other programs. These questionnaires are merely intended to give examples of various types of information that may be obtained in the inventory compilation effort.

GASOLINE SERVICE STATION QUESTIONNAIRE

Name of station ____________________

Address ____________________

Nearest cross street ____________________

Owner ____________________

Operator/operator ____________________

Hours of operation ____________________

	REGULAR	PREMIUM	UNLEADED	DIESEL	KEROSENE	OTHER
NUMBER OF PUMPS						
NUMBER OF TANKS						
TANK SIZE (GALLONS)						
SUBMERGED FILL TUBE						
PREVIOUS MONTH THRUPUT						
ANNUAL THRUPUT						
TIME OF PEAK PERIODS						

(Name) ____________________

(Title) ____________________

(Date) ____________________

Figure C-3-1 Example Area Source Questionnaire for Gasoline Service Stations

EMISSION INVENTORY
DATA YEAR-19
AIRCRAFT OPERATIONS

Airport Name: ______________________ Phone Number: ________

Person to Contact Regarding this Information: ______________

Aircraft Class	Aircraft Type	Engines Per Aircraft	Operations (Take-Off or Landing)
Jumbo Jet	1. Boeing 747	4	________
	2. Lockheed L-1011	3	________
	3. McDonald Douglas DC-10	3	________
Long Range Jet	1. Boeing 707	4	________
	2. McDonald Douglas DC-8	4	________
Medium Range Jet	1. Boeing 727	3	________
	2. Boeing 737	2	________
	3. McDonald Douglas DC-9	2	________
Turboprop	1.	2	________
	2.	4	________
Business Jet	1.	2	________
General Aviation Piston	1.	1	________
	2.	2	________
Helicopter	1.	1	________
	2.	2	________
Military Jet (Specify)	1. ______________	1	________
	2. ______________	2	________
	3. ______________	3	________
	4. ______________	4	________
Military Piston (Specify)	1. ______________	2	________
	2. ______________	4	________

Seasonal Variation in Operations

Jan,Feb,Mar	Apr,May,Jun	Jul,Aug,Sep	Oct,Nov,Dec
________%	________%	________%	________%

Figure C-3-2 Example Area Source Questionnaire for Aircraft Operations

TYPICAL TIME IN MODE FOR LANDING TAKEOFF CYCLE AT A METROPOLITAN AIRPORT

Aircraft	Time in mode, minutes				
	Taxi-idle	Takeoff	Climbout TO 3500 FT	Approach FROM 3500 FT	Taxi-idle
Jumbo jet	19.00	0.70	2.20	4.00	7.00
Long range jet	19.00	0.70	2.20	4.00	7.00
Medium range jet	19.00	0.70	2.20	4.00	7.00
Air carrier turboprop	19.00	0.50	2.50	4.50	7.00
Business jet	6.50	0.40	0.50	1.60	6.50
General aviation turboprop	19.00	0.50	2.50	4.50	7.00
General aviation piston	12.00	0.30	4.98	6.00	4.00
Piston transport	6.50	0.60	5.00	4.60	6.50
Helicopter	3.50	0	6.50	6.50	3.50
Military transport	19.00	0.50	2.50	4.50	7.00
Military jet	6.50	0.40	0.50	1.60	6.50
Military piston	6.50	0.60	5.00	4.60	6.50

The emissions from the aircraft are calculated on the basis of the typical time in mode table above. For those aircraft you are familiar with, are the mode times given in the table similar to those experienced at your airport. If there is a significant difference we would like to contact you at a later date to correct the mode times for your specific operation.

Figure C-3-2 (cont'd.)

EMISSION INVENTORY
DATA YEAR-19
RAILROAD LOCOMOTIVES

Company Name: ____________________

Person to Contact Regarding this Information:

____

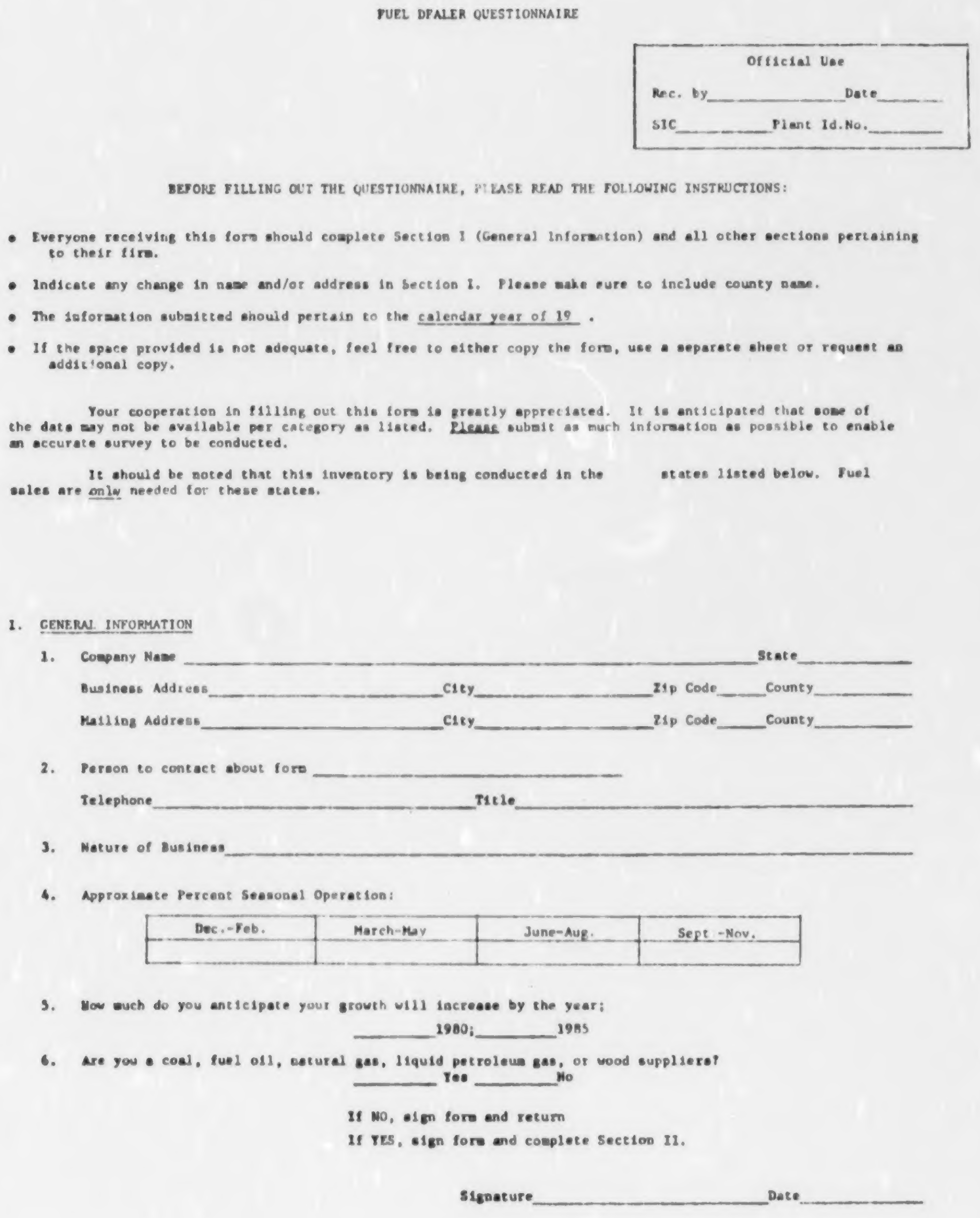
Phone Number: __________

Engine Category	Fuel Consumed Within the Boundaries of County in 19 GALLONS Main Line	 Switch Yard
2-Stroke Supercharged Switch	______	______
4-Stroke Switch	______	______
2-Stroke Supercharged Road	______	______
2-Stroke Turbocharged Road	______	______
4-Stroke Road	______	______

Seasonal Variation in Fuel Usage

Jan,Feb,Mar	Apr,May,Jun	Jul,Aug,Sep	Oct,Nov,Dec
______%	______%	______%	______%

Figure C-3-3 Example Area Source Questionnaire for Railroad Locomotives



FUEL DEALER QUESTIONNAIRE

Official Use	
Rec. by__________	Date______
SIC__________	Plant Id.No.__________

BEFORE FILLING OUT THE QUESTIONNAIRE, PLEASE READ THE FOLLOWING INSTRUCTIONS:

- Everyone receiving this form should complete Section I (General Information) and all other sections pertaining to their firm.
- Indicate any change in name and/or address in Section I. Please make sure to include county name.
- The information submitted should pertain to the calendar year of 19 .
- If the space provided is not adequate, feel free to either copy the form, use a separate sheet or request an additional copy.

Your cooperation in filling out this form is greatly appreciated. It is anticipated that some of the data may not be available per category as listed. Please submit as much information as possible to enable an accurate survey to be conducted.

It should be noted that this inventory is being conducted in the states listed below. Fuel sales are only needed for these states.

I. GENERAL INFORMATION

1. Company Name ______________________________ State__________

Business Address__________________ City__________________ Zip Code_____ County__________

Mailing Address__________________ City__________________ Zip Code_____ County__________

2. Person to contact about form ______________________________

Telephone______________________________ Title______________________________

3. Nature of Business______________________________

4. Approximate Percent Seasonal Operation:

Dec.-Feb.	March-May	June-Aug.	Sept -Nov.

5. How much do you anticipate your growth will increase by the year;

__________ 1980; __________ 1985

6. Are you a coal, fuel oil, natural gas, liquid petroleum gas, or wood suppliers?

__________ Yes __________ No

If NO, sign form and return

If YES, sign form and complete Section II.

Signature______________________________ Date__________

Figure C-3-4 Example Area Source Questionnaire for Fossil Fuel Use

II. 19 FUEL SALES

IMPORTANT: It should be noted that sales represented in this survey do not include sales to other fuel dealers (i.e., only to those sources listed in the table).

Where available provide the sales per category and indicate appropriate units in the last column.

	Type of Fuel*	State	County	Annual Quantity				
				Residential	Commercial/ Institutional	Industrial	Total	Units
EXAMPLE:	Bituminous Coal	X	Y	1,503	2,675	9.632	13,810	Tons/yr.
EXAMPLE:	Natural Gas			3,715	7,301	17,832	28,848	1000cf/yr.
EXAMPLE:	#2 F. O.			133	1,504	19,304	20,941	Gal/yr.

DEFINITIONS: Residential: All residential dwellings from single family residences to apartment complexes

Commercial/Institutional: Retail and wholesale stores, schools, hospitals, government and public buildings

Industrial: All manufacturing industries regardless of size including utilities.

For coal and fuel oil provide an average value of the percent sulfur by weight:

Distillate Oil ____%S Bituminous Coal ____%S
Resident Oil ____%S Anthracite Coal ____%S

*For fuel oils specify number, if available, and for coal specify type (i.e., anthracite or bituminous).

Figure C-3-4 (cont'd.)

19 FUEL SALES

Type of Fuel	State	County	QUANTITY				
			Residential	Commercial/ Institutional	Industrial	Total	Units

Figure C-3-4 (cont'd.)